

NEW TECHNICAL INFORMATION SECTION



MODEL ROCKET

SUPPLIES
CATALOG

CAT. NO. 691

ESTES INDUSTRIES, INC. / BOX 227 / PENROSE, COLORADO



What is Model Rocketry?



Model rocketry is the anticipation of the countdown . . . the lift-off for a perfect flight.

It's the tracking of the vapor trail as your rocket shrinks to a tiny speck — and the "well done" feeling as the parachute blossoms out for a safe recovery. It's your "bird" and you've just challenged a new world . . . and won.

Model rocketry is more than just a hobby, more than the thrill of launching a rocket to a thousand feet in seconds. It's the satisfaction of being a part of the exciting space age, and the challenge to experiment and explore man's greatest frontier.

Scores of young men and women are discovering the value of model rocketry, in school and science fair projects, and in their own private research programs. Designing, building and launching a rocket, puts to use principles of physics, mathematics, aerodynamics, optics, biology, astronautics, electronics, and photography.

Science studies are made more interesting and easier to understand. The space-age hobby also increases interest in related subjects, such as medicine, psychology, and the liberal arts fields. The opportunity to begin studying for a space-age career . . . to take part in the expanding universe of tomorrow . . . to help push our frontier farther & farther outward, toward the stars . . . this is the world of Model Rocketry.

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Penrose, Colorado. LITHO IN U.S.A.



ORDERING INFORMATION

GENERAL INFORMATION

This catalog takes effect as of July 1, 1969 and replaces all previous catalogs. Please be sure that you use the correct and full catalog number for each item you order. All prices are subject to change without notice. **WHEN SENDING ORDER BE SURE TO GIVE ZIP CODE IN YOUR ADDRESS.**

POSTAGE

Estes Industries ships all retail orders postpaid in the U.S. by regular land mail unless the purchaser specifies otherwise. On a few items our price is slightly higher than the normal list on the item. The difference in prices is due to our policy of paying postage on all items. When you place an order for rocket supplies totaling \$4.00, you can be sure there are no hidden charges; All you pay is \$4.00, no extra postage, no handling and no service charges.

PAYMENT ON ORDERS

Full payment must accompany all orders. Please send all remittances by either check or money order, both for your protection and our convenience. If you do send currency, be sure your envelope has sufficient postage, is properly sealed, and is addressed correctly, so we will receive your order. Coins should be attached to a separate sheet of paper, not to the order blank. Use a single strip of masking tape to hold the coins in place. Avoid the mailing of coins, as they are easily lost in the mail. We cannot assume responsibility for the loss of coins, currency or orders in the mail. Remember to include sufficient funds with your order. For your protection, **we do not ship orders C.O.D.** Proper attention to these details will result in speedier service for you.

CAUTION

We believe that we have the safest program offered in the field of rocketry today. However, it is still important that the utmost care be exercised in the use of our products. We **DO NOT** assume any responsibility for accidents. No warranty is either made or implied as to reliability or performance. We assume no liability beyond the cost of replacement of a product, if any, which malfunctions or is found defective.

POSTAL REGULATIONS

Postal regulations permit us to ship only 3 rocket engines per parcel. If all of your order does not come at the same time, please be patient—give Uncle Sam a few days to mix things up and sort them out again.

NOTE: All foreign orders require additional postage. Please write for more information.

ORDER FORM



ORDER FORM

CNX7128

USE THIS CONVENIENT ORDER
FORM FOR FAST SERVICE

YOUR ROCKET SUPPLIES WILL BE
ON THEIR WAY TO YOU THE SAME
DAY WE RECEIVE YOUR ORDER!



*WELCOME to
the exciting world
of rocketry*

Vernon Estes, president of Estes Industries, explains cluster ignition techniques to local rocketeers.

Welcome . . .

to Estes Industries and to model rocketry, America's fastest growing scientific hobby. It is our wish to make your participation in the Estes' program of model rocketry mean more than just finding a place to buy rockets.

As an Estes customer, you will not only have the advantage of obtaining the best materials at the lowest price, but you will also be kept informed of the latest developments as you receive the "Model-Rocket News". Our Technical Reports (TR's) offer a helping hand when it comes to designing your own rockets and an invaluable aid to learning the scientific principles of rocket construction and flight. In addition our Rocketeer Mail Department is always ready to help you with your special needs.

We invite you to send us your own rocket designs, project ideas and safety suggestions. Each one will be carefully studied and many put to use. Thus you will play an important part in helping to establish and maintain the safest and most educational rocket program in the world.

If you have the opportunity, please stop in and see us. We will be pleased to show you around.

Sincerely,

Vern



Meeting the Space Age Challenge

Model rockets are not toys. They are flying, miniature counter-parts of the vehicles of the space age. Constructed primarily of lightweight balsa and paper tubing, model rockets use and demonstrate principles of orbital launch and space vehicles.

Because their design and flight characteristics are similar to space rockets, model rockets present a way for young people of today to meet the challenge of the space age for tomorrow.

In the ESTES line there are basic model rockets which are easy to build and fly. Then as the model rocketeer's knowledge and skills develop, he goes on to more advanced and difficult rockets and projects. Throughout his "rocketry career" his success will be assured by the use of the safety proven ESTES solid propellant engines.

The most effective learning comes through doing. As a rocketeer develops skill and knowledge by building and flying rockets, he develops an active and inquiring mind. The ESTES program of model rocketry guides young people in this direction. This program is effective because it includes the finest rocketry materials available and a continuing flow of helpful information. Model rocketry-as a form of youth science study has no equal for practical experience aimed at a space age career.

The future holds an exciting promise for young people who are prepared to meet its challenge. The greatest frontier man has ever known is opening. Young rocketeers are taking their first steps as pioneers in this great frontier.

Model Rocketry Meets the Space Age Challenge



ESTES

MODEL ROCKET SAFETY

A recognized safety code — plus
safe rocketry materials — equals
14 million safe rocket launches



The ESTES program of model rocketry was developed to meet the challenge of the space age. Working with this program and the safety-proven ESTES products, model rocketeers have established a safety record better than most "common" sports. This safety code is presented to help each of America's model rocketeers to do his part to continue this excellent record.

ROCKETEER'S CODE OF SAFETY

1. I will not attempt to compound propellants or other combustible chemicals or tamper with pre-manufactured rocket engines. I will not use model rocket engines for purposes other than those for which they are recommended by the manufacturer. I will inspect each rocket engine before use and never use an engine which shows signs of physical damage, remembering that any rocket propellant can be explosive under certain conditions.
2. I will not smoke near rocket engines, launch my rockets in the presence of highly combustible materials, use flammable recovery wadding or engage in any activity which would present a fire hazard.
3. I will never use any metallic rocket engines, will not construct my model rockets with substantial metal parts in the area of the engine, and will not launch my rocket over 16 ounces in weight or containing more than 4 ounces of propellant in compliance with Federal regulations.
4. My model rockets will be electrically ignited, using a launch system with either a switch protector or a safety interlock to prevent accidental ignition of the rocket engine, and I will remain at least 10 feet away from any rocket which is being launched. I will use only igniters of the type recommended by the engine manufacturer.
5. I will launch my model rockets using a launching rail or other suitable guide means aimed within 25 degrees of the vertical to assure a safe and predictable flight path, and will launch only rockets whose stability characteristics have been predetermined.
6. I will not fly model rockets in high winds, conditions of low visibility, in the vicinity of low flying aircraft, near tall buildings, near people not aware of the launching, or under any conditions which might endanger property or persons.
7. I will not launch rockets so that their ballistic trajectory will carry them against targets on the ground, and will never use an explosive warhead or other pyrotechnic payload in a rocket.
8. My model rockets will contain recovery devices which will deploy at an altitude of at least 50 feet to return the rocket safely and undamaged. To insure proper operation of my rocket's recovery system I will make a careful pre-launch inspection of all the recovery components with special attention to lightness of the engine and nose cone.
9. To prevent accidental eye injury I will always either place the launcher so the end of the rod is above eye level or cap the end of the rod with my hand when approaching it. I will not place my head or body over the launching rod.
10. When conducting research activities with unproven designs or methods I will, when technically possible, determine their reliability through pre-launch static tests, and I will conduct launchings of unproven designs in complete isolation from persons not participating in the actual launching.

ROCKETEER'S PLEDGE

I am proud to be a model rocketeer. I feel it is important to do my part in upholding the outstanding safety record that model rocketry has gained. In all my rocketry activities I will act in a mature manner and will always be considerate of other people and property rights. I pledge to follow the Rocketeer's Code of Safety.



BUILDING and FLYING MODEL ROCKETS

*The more you build and fly
..... the more you learn*

You may want to build and fly rockets just for the excitement and enjoyment that model rocketry gives you . . . or you may be building them as an educational stepping stone toward a space career.

Either way you can't help but learn science principles.

In both cases we've designed the Estes Program of Model Rocketry to help you build better rockets and learn more about space age rocketry.

*Use this catalog as a doorway for
technical information and supplies*

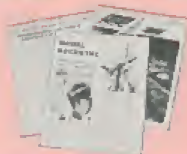
One of the best things about this rewarding hobby is that it's easy to get started. Everything you need is right here in this catalog. Basic materials are light weight balsa wood, paper tubing and a little glue. With ordinary modeling tools you'll be on your way.

You have a challenging selection of ready-to-assemble, precisely engineered kits to build and fly. Easy to follow instructions guide you step by step. These kits, together with materials and technical information for your own designs, will help you to get the most from model rocketry.

In addition to all of this you will be flying your models with inexpensive and reliable Estes model rocket engines.

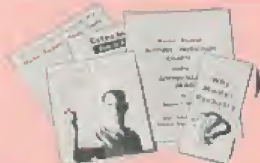
From the ranks of today's rocketeers will come many of tomorrow's space scientists. As an Estes model rocketeer you can open the door to the future. There are unlimited scientific horizons ahead for the person who enjoys this creative activity.

Have fun with safety-proven Estes model rockets while you continue to learn.



Technical Information Services

Rocketeers have a wealth of valuable information available from the Estes research department: New product innovations; information on new techniques; technical reports (TR's); and the informative and educational Model Rocket News, distributed free to customers.



Educational Services Department

Headed by an experienced science teacher, this department provides many services to educators at all levels. Instructional materials are available at no cost to schools. As a teacher, please write your request on your school letterhead.

CHALLENGING and REWARDING



*For real success, follow
this planned Model Rocket Program*

By starting with the basic models you'll soon be tackling more complicated ones and mastering advanced subjects and designs. The following program of study has proven to be helpful to thousands of rocketeers like yourself.

Basic Building — Start your program by building and flying the Astron Alpha, an outstanding basic rocket design. Study technical report TR-1 (included in the kit) to gain a good understanding of rocket stability principles so important to performance.

Stability Studies — Increase your understanding of stability principles by building and flying the Astron Scout.

Design Planning — Gain skills in rocket design by studying technical report TR-9. It is an excellent guide for creating your own single stage rocket. Build and flight-prove your own design.

Multi-Staging — Introduce yourself to multi-staging with a 2-stage Astron Apogee. Technical report TR-2, with the kit, explains stage coupling, separation and upper stage ignition. Study carefully as you build and fly.

Advanced Multi-Staging — Add to your skill in multi-staging by building and flying a 3-stage Farside, using experience gained from the Apogee.

Custom Design I — Challenge yourself by designing, building and flying your own multi-stage model, using the techniques you've learned.

Boost-Glide — This is departure from the traditional rocket. Build and fly the Astron Falcon which combines rocket and glider characteristics. Technical report TR-7 (with kit) gives precise instructions on FRONT ENGINE models.

Broaden your boost-glide skills with the Astron Space Plane, a REAR ENGINE model. By studying included technical report TR-4, you'll gain further knowledge in the art of balancing for maximum performance.

Custom Design II — Now test the boost-glide principles you've learned from the Space Plane and Falcon. Design and build your own Boost-glider.

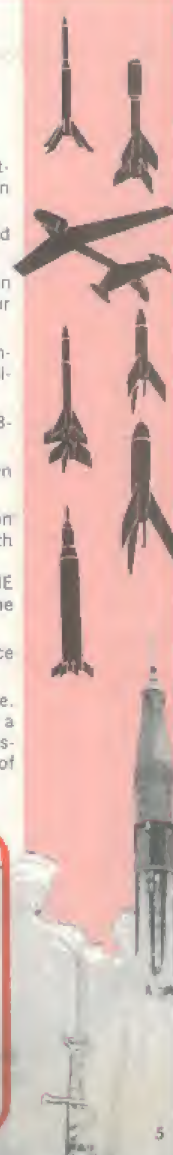
Clustering — This is the technique of simultaneously igniting more than one engine. Master it by building the Astron Scrambler, studying TR-6 (with kit) and launching a payload with your model. Continue studies of clustering by building and flying the Astron Ranger or one of the clustered Estes scale models. Then build a cluster model of your own design.

RESEARCH

Through your studies and research you will learn that there is more to model rocketry than just the thrill of the launch. You will have discovered practical applications of the science subjects you've studied in school. You'll look forward to new fields to explore.

Look for research projects for your own research program. To assist you, several good books are listed in our catalog. Your school or public library has many more. Aerial photography, space medicine, electronics, aerodynamics, meteorology and physics are but a few of the fields open to ambitious model rocketeers.

Keep studying and researching. Use your studies to develop a prize winning project. Look to the future — the frontiers of space have barely opened. Curiosity and research of young people like yourself will expand these frontiers.



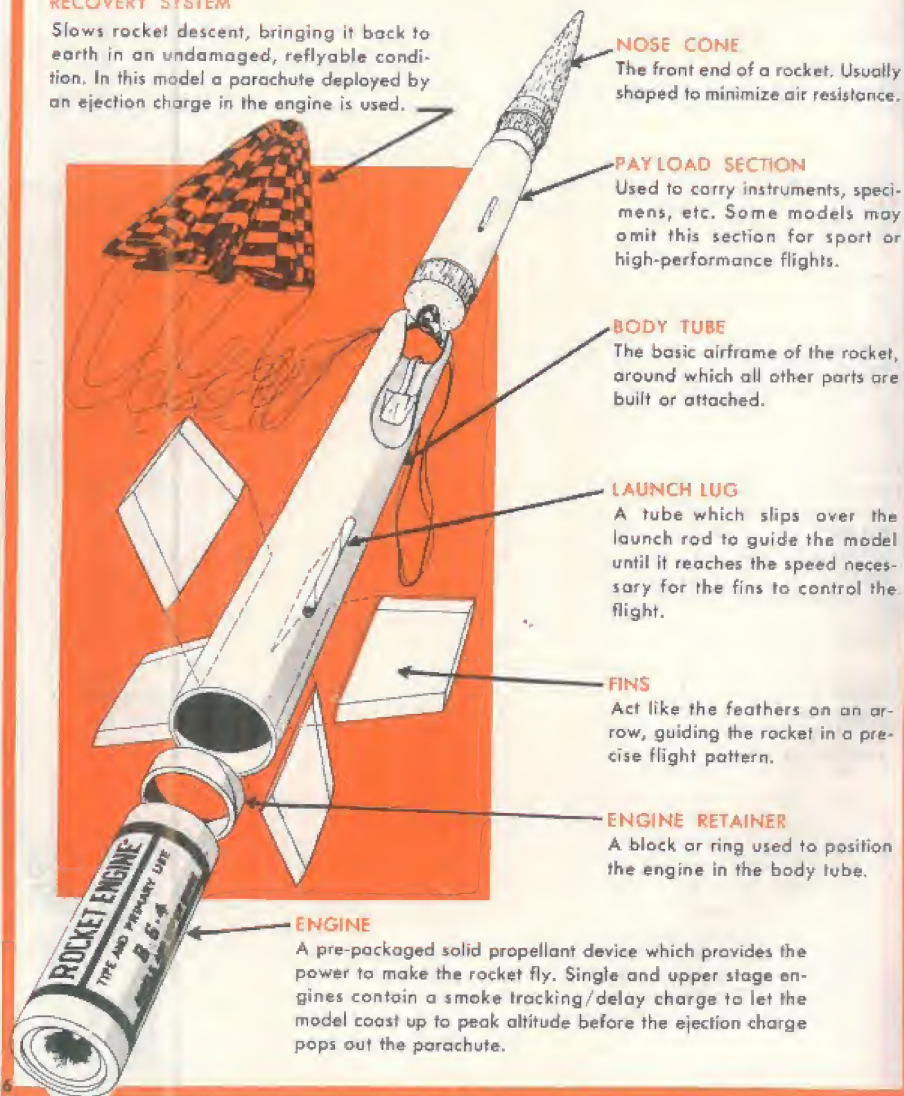
GET
THE
MOST
FROM
MODEL
ROCKETRY

Basic Model Rocket Components

Model rockets vary greatly in appearance and purpose, but whether for sport and recreation or scientific experiment, most models use certain basic components. The arrangement and functions of these components are explained in the diagram of a typical working rocket shown below.

RECOVERY SYSTEM

Slows rocket descent, bringing it back to earth in an undamaged, reflyable condition. In this model a parachute deployed by an ejection charge in the engine is used.



Rocket coasts upward to peak altitude during time delay

Engine ejection charge activates to deploy chute or other recovery system

Model Rocket Flight

Powered Flight

Complete instructions for launching model rockets are included with all engines sold by Estes Industries.

Model is launched electrically from center of flight area

Model rocket launch and recovery area

GENTLE LANDING

Model rocket drifts safely to earth



START RIGHT FLY RIGHT

...with the safe and
educational program
of Estes model
rocketry



Kit includes: Electro-Launch kit :: FS-4, 4 batteries
:: PFB-1, Astron Alpha kit :: K-25, 1 engine
:: 1/8 A6-2, 1 engine :: AB-3,
design manual :: P-1



STARTER KIT

- ★ the high flying, easy-to-assemble Alpha kit, 2 engines, instructions
- ★ Electro-Launch — self contained electric launcher, with batteries
- ★ fact filled design manual

**ONLY
\$7.00**

Lift off with confidence when you start with this complete outfit. The ASTRON ALPHA is an easy rocket to build and fly and demonstrates most rocketry principles. Parachute recovery will bring your "bird" back for flight after flight. The ELECTRO-LAUNCH is the "biggest little launcher" in the world. Its advanced features are explained on page 86. You'll use it throughout your rocketry career. To get you off to the right start the comprehensive Estes DESIGN MANUAL is included. Shipping wt. 2 lb., 8 oz.

Cat. No. 691-DSK-70
\$7.00

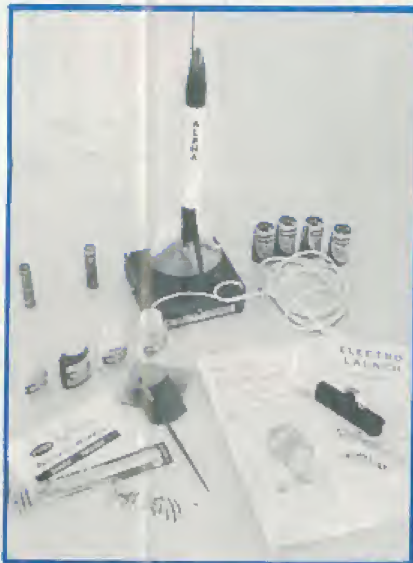


Deluxe Starter Special
including building and
finishing materials on
page 10

\$2.00 BEGINNERS SPECIAL

For those who have a launcher available or wish to build their own (instructions incl.), all the above items except the Electro-Launch and batteries are included. Shipping wt. 11.5 oz.
Cat. No. 671-DSK-20 \$2.00

DELUXE STARTER SPECIAL



This is the most complete outfit ever offered for people who have done no previous model building. At the low price of \$8.50 you get everything needed to get off the pad: rocket, engines, launcher, tools and paints. As a special bonus an authoritative manual on rocketry is included.

- Astron Alpha kit. #K-25
- Electro-Launch kit #FS-4
- 4 Batteries #PFB-1
- 1 Engine #1/2A6-2
- 1 Engine #A8-3

PLUS

a knife, glue, points, brush, brush cleaner, sandpaper — supplies which can be used in building several more rockets

Shipping wt. 3 lb., 11 oz.

Cat. No. 691-D5K-85 \$8.50

ASSEMBLY SPECIAL

A Complete Construction and Finishing set

One convenient package, containing all the tools and supplies recommended for assembling, painting, and decorating most model rockets. Ideal for the beginner who doesn't already have modeling equipment. This set helps you build the best models right from the start.



- | | | |
|-----------------------------------|--------------------------------------|-----------------------------|
| 1 Bottle White Glue #WG-1 | 1 Bottle Dope Thinner #BDT-1 | 1 Knife #KNS-3 |
| 3 Emery Boards #BE-1 | 1 Bottle White Dope #BRD-1 | 18 Sheets Sandpaper #SPA-2 |
| 1 Bottle Sanding Sealer #SS-1 | 1 Roll Masking Tape #MT-1 | 3 Point Brushes #PB-3 |
| 1 Bottle Silver Dope #BRD-1 | 1 Bottle Black Dope #BRD-1 | 1 Bottle Orange Dope #BRD-1 |
| 3 Sheets Sanding Material #SP-320 | 1 Gold Mine Special Decal Sheet #D-5 | |

Cat. No. 691-CK-3 A, shipping wt. 1.5 lb. \$3.20

Astron ALPHA

A High Performance
"first"

... great "first" rocket for you to build and fly



Specifications: Length 12.25 in. Body Dia. 0.976 in.
Weight 0.76 oz. Fin. Span. 4 in.

Recommended Engines: 1/2A6-2, A8-3, A5-4, B4-4, B6-4, C6-5

An exciting rocket to fly. From "lift-off" to recovery, it demonstrates superior flight characteristics. The easiest parachute model to "prep" and fly. With its low weight and streamlined design, the Alpha will reach high altitudes consistently. An excellent model to have in your rocket fleet. The choice of experienced modelers because of its high performance and dependability.

Kit includes technical report TR-1 (Engines not included in kit)

Cat. No. 671-K-25, shipping wt. 8 oz. \$1.50

PARACHUTE RECOVERY/QUICK ENGINE CHANGE

Astron

STARLIGHT

Parachute
Recovery

UNIQUE DESIGN DEMONSTRATION AND SPORT ROCKET

Advanced design incorporates large fin area for exceptional stability. Launches straight up to extreme altitudes, even in moderate winds (but remember the parachute drift you get with wind). Graceful in flight, its unique fin design makes it ideal for display. Comes with all parts and instructions. Engines not included. Shipping weight 9 oz.

Cat. No. 681-K-32.....\$2.35

Length.....18"
Body Dia.....0.976"
Weight.....2 oz.

\$2³⁵

Recommended Engines
1/2A6-2 A8-3
B6-4 C6-5

Astron

Sky Hook

- EASY TO BUILD
- TERRIFIC PERFORMER
- PARACHUTE RECOVERY

You'll really enjoy building and flying your Astron Sky Hook. Easy to build and durable, parachute recovery brings it back gently for flight after flight. Kit comes complete with all parts and instructions (but no engines). Shipping weight 5 oz.

Cat. No. 651-K-8\$1.35

Body Dia. 0.765 in.	Recommended Engines	
Length.....12 in.	1/2A6-2	A5-4
Weight...0.65 oz.	B4-4	B6-6
	C6-7	

(For first flights use 1/2A6-2 engines.)

**ONLY
\$1³⁵**



Astron DRIFTER

GREAT FOR
COMPETITION AND
SPORT FLYING

**2 BIG
CHUTES**

Spectacular in upward flight and recovery, the Astron Drifter combines low weight with large chute capacity. Perfect in any competition with its 24" chute, the Astron Drifter is a great performer with its 12" chute for test and sport flying tool. Parachutes are easily interchanged.

Cat. No. 651-K-14 \$1.75 each
Shipping weight 8 oz.

Recommended
engines are:

1/2 A6-2	A8-3	Body Dia. 0.98 in.
B6-4	C6-5	Length 14.3 in.
Engines not included		Weight 1 oz.



ONLY
\$1.75

2 big 'chutes for
an "EGG"-stremely
soft landing



3-engine boost
for BIG payloads

Astron scrambler

Huge see-through payload compartment holds an egg or other large payload . . . cluster design gives the power to boost it. A great sports model; perfect for contests too. Can carry an egg to over 1000 feet and set it down safely. Has 2 chutes for extra gentle recovery. Comes with all parts and instructions, a complete technical report on clustering and an unusual decal sheet for unique decorating (less engines). Shipping wt. 13 oz.

Cat. No. 682-K-37 \$3.00

Specifications:

Length 23.5 in.
Weight 2.8 oz.
Body Dia. 1.637 in.
Payload Dia. 1.796 in.

Recommended Engines

A8-3	B6-4
C6-5	B14-5

Great for classroom
or science fair!



Weight72 oz
Body Dia.736 in
Length 8.7 in

Complete Cutaway Rocket

Astron PHANTOM

DEMONSTRATES BASIC BUILDING RULES.

This bird will never fly, but it will certainly help get your science fair project or special demonstration off the ground! The Astron Phantom has a transparent body to show all the insides of a model rocket — plus a special dummy engine cut in half to show its insides. A great help in answering questions on model rocketry, the Astron Phantom kit comes complete with all parts and instructions (but no fins). Shipping weight 5 oz.

Cat. No. 651-K-7 \$1.75

Astron **SPRITE**

Ideal for small field sport and demonstration flying

The perfect model for small fields and sport or demonstration flying. The Astron Sprite is easy to build, with tumble recovery to teach principles of rocket balance and bring the model back safely — close to the launcher. Uses lightweight Series III engines only, gives top performance for its size. Kit comes complete with instructions and a copy of TR-1 (but no engines). Shipping weight 5 oz.

Cat. No. 651-K-15 \$.75 each

Specifications	Recommended Engines
Length..... 5.3 in.	1/4 A3-2S
Body Dia..... 0.765 in.	1/2 A6-2S
Weight..... 0.3 oz.	



Patent No.
3,114,317

**HIGH PERFORMANCE
TUMBLE RECOVERY**

Astron **STREAK**

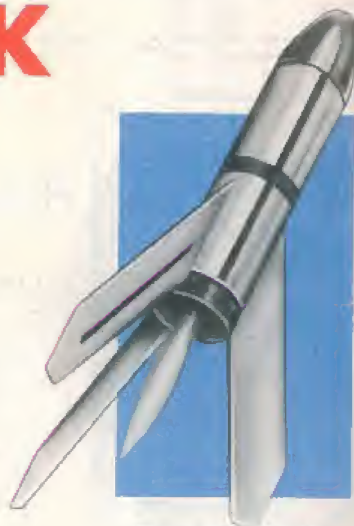
Spectacular Single Engine Performance

2,000 ft. flights Featherweight Recovery

Low weight and wind cheating design give the Astron Streak fantastic performance. Uses mylar body tube for high strength and low weight— only 1/8 ounce without engine. Ideal for contests and records. Recommended engine for normal flying is the 1/2 A6-4. Kit comes complete with all parts and instructions (but no engines). Shipping weight 4 oz.

Cat. No. 651-K-4 \$.50

Body Dia. 0.72 in
Length..... 5.6 in
Weight..... 0.125 oz



Recommended Engines	
1/4 A3-2	1/2 A6-4
A5-4	A8-5
B6-6	C6-7

BIG BERTHA

SINGLE ENGINE OPERATION
PARACHUTE RECOVERY

SIMPLE — RELIABLE
PERFECT FOR DEMONSTRATIONS

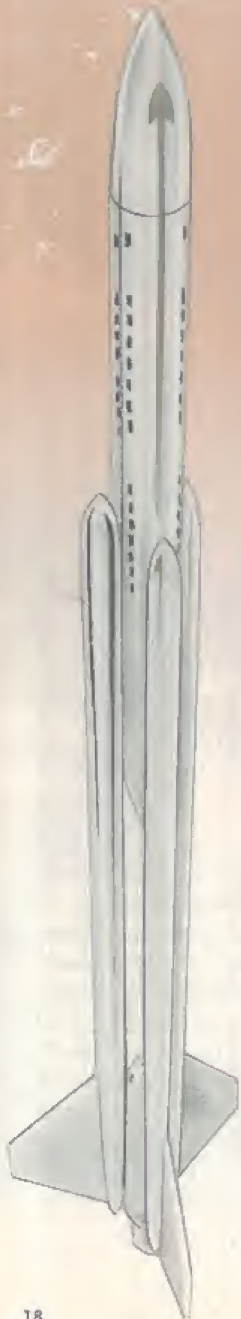


Easy-to-build, reliable and impressive in flight, Big Bertha is an ideal model for demonstration flights. Features a slow, realistic takeoff that fascinates spectators. Big 18" chute gives slow descent and gentle landings. Kit comes complete with all parts and easy to follow instructions (but no engines). Shipping weight 16 oz.

Cat. No. 651-K-23 . . . \$2.00

**ONLY
2.00**

SPECIFICATIONS		RECOMMENDED ENGINES	
Length.....	24 in.	A5-2	A8-3
Body Dia.....	1.6 in.	B4-2	B6-4
Weight.....	2.25 oz.		C6-5



Unique
ejection
system



A REVOLUTIONARY MODEL DESIGN
INSPIRED BY ATOMIC PROPULSION RESEARCH

Futuristic rocket design introduces ejection ducting. This system directs ejection gases through openings in the power tube into three ducting tubes to pressurize the parachute compartment for deployment of the 'chute. You'll want to build this model. It presents a new idea to test, and gives excellent reliability, stability and performance. Uses single-parachute recovery; gives impressive performance flight after flight. Kit comes with all parts and instructions. Engines not included.

Cat. No. 681-K-33 Shipping weight 16 oz. \$4.00

Specifications
Length 31.6"
Main Body Dia. . 0.976" OD
Weight 2.7 oz.
Fin Span 3"
(center to tip)

Recommended Engines
A8-3 B6-4
C6-5 B14-5

\$4.00



Astron

X-RAY

Visible Payload

An easy-to-build high performance single stage payload rocket, the Astron X-Ray features parachute recovery and a large see-through payload compartment. Perfect for research work and sport flying too. Kit comes complete, ready to assemble. Engines not included. Shipping wt. 6 oz.

Cat. No. 651-K-18 \$1.75



SPECIFICATIONS

Length 16.75 in.
Body Dia. 0.736 in.
Payload Section Dia. 0.950 in.
Weight 0.7 oz.

RECOMMENDED ENGINES

1/2 A6-2, A8-3, B6-4, C6-5, B14-5

- SINGLE STAGE
- PARACHUTE RECOVERY

MARS LANDER

Authentic, forward-looking concept in planetary exploration vehicles



- Lands upright on spring-loaded shock-absorbing landing gear
- Parachute recovery
- Single-engine power
- Highly detailed body panels
- Brilliant 4-color decal

Cat. No. 691-K-43 \$4.75

Shipping wt. 16 oz.

RECOMMENDED

ENGINES

B4-2, C6-3
(not included)

SPECIFICATIONS:

Height 12 in.
Body Dia. 3.8 in.
Landing Gear Span 13.2 in.
Weight 3 oz.

MARS SNOOPER

- FASCINATING DESIGN
- PARACHUTE RECOVERY
- IDEAL FOR DEMONSTRATION FLIGHTS

A truly different model rocket, the Mars Snooper combines interesting appearance with reliable performance — makes an excellent model for demonstration flying and display. Features payload section, 18" parachute and precut fins for easier assembly. Recommended for the careful modeler, the Mars Snooper kit comes complete with all parts and detailed instructions (but no engines). Shipping wt. 12 oz.

Cat. No. 651-K-20 \$3.00 each

Specifications

Length	21.7 in.
Body Dia.	0.98 in.
Weight	2.2 oz.

Recommended Engines

A8-3
B6-4
C6-5





Astron

Patent No.
3,114,317

SCOUT

- EASY TO BUILD
- TUMBLE RECOVERY
- EDUCATIONAL

Get valuable experience building and flying the Astron Scout. Kit teaches rocket balance principles. A must for the rocketeer who wishes to learn to design his own models. Kit comes complete with all parts, instructions, and a copy of technical report TR-1 (but no engines). Shipping weight 2 oz.

Cat. No. 651-K-1 \$.70 each

Recommended Engines

1/4 A3-2, 1/2 A6-2, A5-4, A8-3, B6-4, C6-5	Length ... 7 in. Body Dia. 0.765 in. Weight ... 0.28 oz.
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(Use 1/4 A3-2 for first flights.)



Astron

STREAMER
RECOVERY

MARK

**THE NEXT STEP FOR THE BEGINNER
IDEAL FOR SPORT AND
DEMONSTRATION FLYING**

An excellent bird for novice or experienced rocketeer. Easy to build, ideal for sport and demonstration flying, the Astron Mark gives top notch performance. Kit comes complete with all parts and instructions (but no engines). Shipping weight 5 oz.

Cat. No. 651-K-2 \$1.25

Recommended Engines

1/2 A6-2, A5-4, A8-3, B6-4, C6-5	Length 9.12 in. Body Dia. . 0.765 in. Weight 0.65 oz.
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(Use 1/2 A6-2 for first flights.)

ESTES

- PARACHUTE RECOVERY
- PRACTICAL SIZE
- SINGLE ENGINE
RELIABILITY

semi-
scale

SATURN V



Though not fully detailed, this model of the Saturn V is an amazingly good representation of our nation's biggest launch vehicle. Scaled at 1 to 242 it is a practical size to build. With single engine reliability you can count on precise launchings and steady flights. Parachute recovery gives gentle landings. Instructions and all parts included, but no engines. Shipping weight 13 oz.

Cat. No. 681-K-39 \$2.50

RECOMMENDED ENGINES
A8-3, B6-4, C6-5

SPECIFICATIONS
Length 18.1 in.
Body Dia. 1.637 in.
Weight 1.87 oz.

ESTES

SATURN V

Build the big one
... the rocket that took us to the moon

Flying Scale Model

Scaled to 1/100th actual size, it stands 43½" tall. Precision molded plastic tower and other details make this an easy model for the experienced rocketeer to build. Authentic full color decals included. Realistic plastic engine nozzles remove for flight. Three engine cluster lifts your model hundreds of feet to peak altitude where separation occurs. The Apollo capsule returns safely to earth on it's 12" chute; two big 24" chutes gently return the main power section for its next launch. Use a 12 volt car battery and a 12 volt Estes FS-5 (or similar launch control system) for dependable ignition. Engines not included. Shipping wt. 2 lb. 4 oz.

Cat. No. 691-K-36 \$9.95

SPECIFICATIONS

Length..... 43.5 in.
Body Dia..... 3.93 in.
Weight..... 9.9 oz.

RECOMMENDED ENGINE

TYPE: C6-3 (not inc. in kit).
Technical report TR-6 on clustering included with kit.

only
\$9.95

Lofted the lunar module in its first flight test

SATURN 1-B

1 to 70 scale

\$9.50

3 Parachute
Recovery

4 Engine
Power

A thrilling scale model for even the most advanced rocketeer, this bird will be a real challenge to your building and flying skill. A four engine cluster lifts the uprated Saturn model into the air. Two 24" parachutes on the main body and a 12" parachute on the command escape structure return it gently. A real beauty, both in the air and on display. Kit comes complete with all parts, decals, detailed instructions and a copy of Technical Report No. TR-6. Engines not included. Shipping wt. 4 lbs. Cat. No. 671-K-29 \$9.50

Uses a 12 volt car battery and a 12 volt Estes FS-5 (or similar launch control system) for dependable ignition.

Specifications

Length..... 37"
Body Dia..... 3.53"
Weight..... 9.86 oz.

Recommended Engines (All four must be the same.)

A8-3, B6-4, C6-5



**PARACHUTE
RECOVERY
EASY-TO-BUILD
KIT**

High performance scale model of the rocket that started the space age. Easy but interesting to build, the V-2 features reliable parachute recovery for gentle landings. Detailed instructions provide full information on assembly and finishing. Kit comes complete with all parts (but no engines). Shipping weight 7 oz.

Cat. No. 651-K-22 \$1.75 each

Specifications		Recommended Engines	
Length	11.2 in.	1/2 A6-2	A8-3
Body Dia.	1.325 in.	B6-4	C6-5
Weight	1.4 oz.	B14-5	

THE VEHICLE THAT STARTED AMERICA ON THE
WAY TO THE MOON

ESTES
Mercury Redstone

Dual Parachute
Recovery



**True
Scale
Model**

A beautiful rocket to thrill even the most advanced rocketeer. The Mercury Redstone is an exact scale model of the vehicle that boosted Commander Alan Shepard on America's first manned space flight. Scaled at 1 to 42, the model is accurately detailed and includes a complete decal sheet. Although it requires care and precision in construction, the completed model will become one of your favorite rockets. Kit comes complete with all parts and instructions. Shipping weight 16 oz.

Cat. No. 681-K-41 \$2.75

SPECIFICATIONS		RECOMMENDED ENGINES
Length	23.5 in.	A8-3, B6-4, C6-5
Body Dia.	1.637 in.	
Weight	2.1 oz.	

AEROBEE 300

Flying Scale Model

**EASY TO BUILD
HIGH PERFORMANCE
PARACHUTE RECOVERY**

Easy to build scale model of a great sounding rocket. Gives top performance in flight after flight. Features parachute recovery for gentle landings, payload section for small specimens. Kit is complete with all parts and easy-to-follow instructions (but no engines). Shipping weight 14 oz.

Cat. No. 651-K-17\$2.00 each

Recommended	Engines	Specifications	
A8-3	B6-4	Length	20 in.
1/2 A6-2	C6-5	Body Dia.	0.98 in.
		Weight	0.85 oz.

SUBORBITAL APOLLO LAUNCH VEHICLE

LITTLE JOE II

The solid propellant rocket used for testing unmanned Apollo spacecraft under actual flying conditions

*Flying scale
model complete
with Apollo
capsule*



Recommended
Engines
A5-2, A8-3, B4-2,
B6-4, C6-5

1/70th scale

As the first test vehicle for the Apollo mission, the contribution of Little Joe II is significant in NASA'S lunar exploration program.

Specifications

Length 14.5"
Body Dia. 2.217"
Weight 2.0 oz.
Fin Span 4.9"
Shipping weight 16 oz.

This model will rank high in space history. Great for display and for flying. It is designed for great lift-off capability and stable trajectory. The command module, with launch escape structure, has its own 12" recovery 'chute; the booster module is returned safely by a big 24" parachute. Though detailing on the model is intricate, the Little Joe II is easy to build after you've gained experience with less complex models. Kit contains all parts and complete instructions. Engines not included.

Cat. No. 681-K-30\$2.75

APOLLO SPACE CAPSULE

with launch
escape structure

Fits BT-70 Body Tubes — Average Weight .36 oz.

Realistic 6.6 inch long scale model of the space capsule that carried our astronauts on the first trip to the moon. Precisely detailed, it can be built for either launching or display. Identical to the capsule on the Estes Saturn 1B and Little Joe II kits step-by-step instructions, assembly jig and die cut parts make it relatively easy to build.

Cat. No. 681-NCK-29\$1.75

Shipping weight 5 oz.



1 to 70
SCALE
MODEL

Scale Model of the Famous Sounding Rocket

WAC CORPORAL

- ★ EASY TO BUILD
- ★ GREAT FOR FLYING
- ★ FINE DISPLAY MODEL
- ★ PARACHUTE RECOVERY

High-flying scale model is easy enough for the novice to build, yet interesting enough for the experienced rocketeer. The famous WAC CORPORAL gives top scale model performance. Parachute recovery gives gentle landings flight after flight. Comes in easy to assemble kit form. (Engines not included.) Ship. wt. 5 oz. Kit includes technical report TR-1.

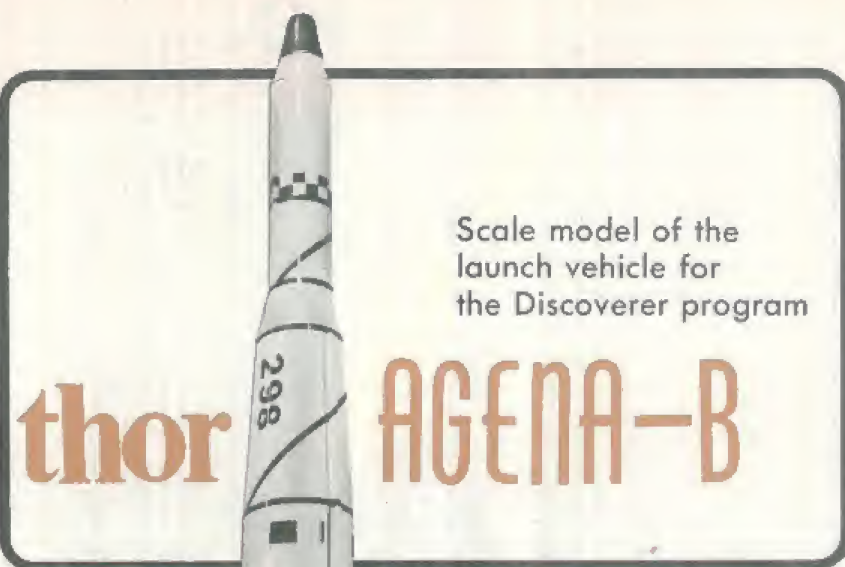
Cat. No. 651-K-11 \$1.50

SPECIFICATIONS

Body Dia. 0.736 in.
Length 11.8 in.
Weight 0.65 oz.

RECOMMENDED ENGINES

½A6-2 A8-3
B6-4 C6-5
(Use ½A6-2 engines
for first flights.)



Scale model of the
launch vehicle for
the Discoverer program

thor

AGENA-B

Flying Scale Model

Actual scale model of the famed N.A.S.A. booster that lofted such satellites as Aloette (Canada's first satellite), Nimbus (the U.S. weather satellite) and many more. Colorful 18" chute brings it back gently. Features clear plastic fins to stabilize model in flight without detracting from its appearance. Easy to build, comes complete with all parts and easy-to-follow instructions (but no engines). Shipping wt. 13 oz.

Cat. No. 671 - K-28 \$2.50

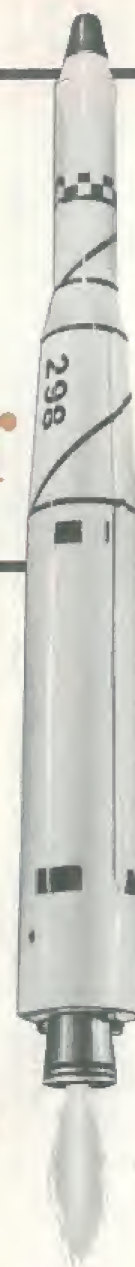
\$2.50
ppd.

RECOMMENDED ENGINES

A8-3, B6-4, C6-5

SPECIFICATIONS

Body Dia. 1.637 in.
Length 17.25 in.
Weight 2.16 oz.



HONEST JOHN

SCALE MODEL
OF U.S. ARMY'S
SURFACE-TO-SURFACE BALLISTIC MISSILE

- PARACHUTE RECOVERY
- DECALS FOR AUTHENTIC MARKING

A beautiful scale model that performs with brilliance. Lifts off the launch pad fast and streaks skyward straight and true. Recommended for experienced modelers, the kit comes complete. An exciting flight model and a historic one for your display shelf. Shipping wt. 14 oz.

Cat. No. 671-K-27 \$2.00

RECOMMENDED
ENGINES
1/2A6-2, A8-3
A5-4, B6-4, C6-5

SPECIFICATIONS
Weight 1.19 oz.
Length 13.75 in.
Fin Span 4.4 in.
Body Tube Dia. 0.976 in.

Scale Detail by G. Harry Stone



GEMINI-TITAN

GT-3

SEMI-SCALE MODEL
SPECTACULAR FLIGHTS
PARACHUTE RECOVERY
TWO ENGINE POWER

\$4.00
EACH

Spectacular on the ground and in the air, the Gemini-Titan is a challenge to build and fly. Requires experience to build, but the GT-3 is a rocket that the modeler can point to with real pride when he's finished it. Features clear plastic fins to stabilize it in flight without detracting from its appearance, full 24" parachute for soft landings. Requires 24 volt Electro-Launch or 12 volt car battery power supply for launching. Kit is complete with all parts and detailed instructions (but no engines). Shipping weight 16 oz.

Cat. No. 651-K-21 \$4.00 each

Specifications	Recommended Engines
Length 24.4 in.	A8-3, B6-4, C6-5
Body Dia. 2.22 in.	
Weight 3.8 oz.	

Kit includes technical report TR-6





**FLYING
SCALE
MODEL**

Sleek and Slender **ARCAS[®]**

for exciting probes
into the atmosphere

Precise scale model of the famous ARCAS[®] sounding rocket. A handsome model to display, an exciting one to launch. Zooms hundreds of feet into the sky; returns gently by its 18" multi-color parachute ready for a fresh engine and another flight. Easily assembled, kit comes complete with all parts, decal and instructions. Shipping wt. 14 oz.

Cat. No. 671-K-26 \$2.00

RECOMMENDED ENGINES

A5-2 A8-3, B6-4, C6-5 (not included)

SPECIFICATIONS

Body Dia. 1.325"
Weight 1.44 oz.
Length 22.82"
Fin Span 3.82"

\$2.00

Registered Trademark of the Atlantic Research Corp., Alexandria, Va.

ORBITAL TRANSPORT

Futuristic
Design



Releases re-entry glider in flight

Spectacular in flight and a true show model on the ground, the Orbital Transport is the launch vehicle of the 80's. Based on the latest proposals for a reusable air breathing (scramjet) booster for orbital vehicles, the Transport is an exciting experience to build and fly. The Transport itself lifts off under rocket power. At ejection the "re-entry vehicle" detaches and glides back to earth. The booster returns by parachute. Kit comes complete with colorful decals and a fact-filled data sheet on the air breathing booster concept. Shipping wt. 16 oz.

Cat. No. 683-K-42 (Engines not included.) . . \$2.50

only
\$2.50

SPECIFICATIONS

Recommended Engines
B6-4 C6-5

Booster

23.0 in.
7.9 in.
2.0 oz.
0.976 in.

Re-entry Vehicle

Length 8.6 in.
Wingspan 5.0 in.
Weight 0.5 oz.
Body Diameter 0.736 in.

Astron

nighthawk

POP-POD BOOST GLIDER

\$1.75

- Revolutionary design
- Perfect for sport, demonstration and contest flying.
- Programmable boost phase
- Simplified construction
- High performance



Swish! Straight up
for hundreds of feet . . .

Then pop! The power pod separates
and drifts down on its own parachute
as the glide vehicle circles lazily against the blue sky.

Revolutionary pop-pod system is pre-programmable for perfect upward flights. Glider portion's unique design features minimum weight and drag for long flight duration. The Nighthawk is an ideal model for duration contests, research flying and demonstrations of boost-glider operation. Recommended for the experienced rocketeer, the kit comes complete with all parts and instructions (but no engines).

Cat No. 681-K-34 . . . \$1.75 each

Shipping weight 14 oz.

Recommended Engines
1/2A6-2, A5-2, B4-2

Weight . . . 1.36 oz.
(complete vehicle)

Weight . . . 0.67 oz.
(glider only)

Wing Span 16 1/4 in.
Length . . . 19 1/4 in.

Power pod and
glider separate
for descent

Astron

falcon



Kit includes technical report TR-7

Patent No. 3,114,317

ROCKET GLIDER . . .

FLAT GLIDE

LONG DURATION

SPECIFICATIONS
Length . . . 12 in.
Wing Span . . . 10 in.
Weight . . . 0.40 oz.

RECOMMENDED ENGINES
1/4A3-1 1/2A6-2
A5-2 B4-2

Get sky-high performance with the Astron Falcon boost-glider. Beautiful climb — glide durations up to and over 1 1/2 minutes on 1/2A engines, even more with larger engines. (For normal flying 1/2A6-2 engines are recommended — the Astron Falcon can easily glide out of sight with larger engines if it is built and balanced carefully.) A great bird for the experienced rocketeer. Glide recovery brings it back gently, ready for a fresh engine and another flight. Kit comes complete with all parts and instructions (Engines not included). Shipping wt. 5 ounces.
CAT. NO. 651-K-13 . . . \$1.00



Patent Pending

ONLY
\$400

Lens opening — f-16
Shutter speed — 1/1000
Focal Length 3" (76 mm)

RECOMMENDED ENGINES

Multi-Stage Flights

Booster Upper Stage
B14-0 B14-6 B14-7 C6-7

Single Stage Flights

B14-5 B14-6 C6-7

SPECIFICATIONS

Diameter 1.6"
Length 5.3"
Wt. 1.26 oz.



CAMROC

ROCKET CAMERA

Build the Camroc and launch the most ingenious payload in model rocketry today. This space age aerial camera system automatically takes a picture from hundreds of feet in the air and returns safely with the lightweight rocket that launched it. Uses a single exposure film disc mounted in a light-tight holder for quick and easy replacement in the field. Fits body tube BT-50. Negative is 1½ inches in diameter. Kit contains: all parts and instructions for assembly and operation; 1 film holder loaded with unexposed film; 1 empty film holder and exposed film disc for practice loading and experimenting. Shipping weight 7.5 oz.

Cat. No. 651-C-1 \$4.00

**SAVE
50¢**

SPECIAL OFFER

Complete Camroc kit plus the Astron Delta kit, shown on page 41. This gives you the best basic outfit for taking aerial photos. Engines not included. Shipping weight 10 oz.

Cat. No. 651-RC-1 \$5.00

NOTE: While the camera system is quite easily operated, we recommend that you first learn rocketry building and launching in preparation for camera work.

CAMROC OPENS AN EXCITING FIELD FOR THE ADVANCED ROCKETEER

Aerial photography has long been acknowledged for its value in map making, geographical studies, reconnaissance and related research fields. Now with the Camroc aerial camera a new field of science studies is opened to the rocketeer who wants to get a better understanding of the scientific uses of aerial photography. Recommended booster vehicle is the Delta. Other models can be adapted.

In addition to learning principles of camera construction and operation, many challenging aerial photographic projects can be developed.

Study space science reconnaissance techniques the practical way — over familiar terrain with known objects. Map your flight area with Camroc photos. Use photo pairs, which produce a stereoptic image when properly viewed, to emphasize geological features or estimate heights of different objects quite accurately. One example of the wide range of aerial photo techniques is shown on page 40.

Processing
information and
photo techniques
on page 40



Negative 1½" dia.
Print size 3" dia.

Patent Pending

These photos illustrate two of the many types of aerial photographs possible with the Camroc.



CAMROC EXPERIMENTAL TECHNIQUES



At left is a straight down "vertical" photo. The "oblique" shot at the right, showing perspective, covers a wider expanse, but with less detail. Instructions included with the kit suggest techniques you can use to obtain photos with different perspectives.

PROCESSING AND SUPPLIES

Rocketeers who have access to a photographic darkroom can develop and print negatives from the Camroc with no difficulty. For those who would rather not do their own processing, Estes Industries offers developing and printing service. Prints produced are enlarged to twice the negative size. Recommended film is Estes Industries Astropan 400 or identical Kodak Tri-X. Both films are rated at A.S.A. 400 but pushed to A.S.A. 1200 in development. **IMPORTANT:** All Camroc film not in light-tight holders **MUST BE HANDLED IN TOTAL DARKNESS.**

ALL PROCESSED NEGATIVES AND PRINTS ARE RETURNED BY AIR MAIL WHEN DISTANCE IS OVER 400 MILES

LOADED FILM HOLDERS

Extra film holders for in-the-field changing are available for the Camroc. They come 4 to an order, each pre-loaded with a fresh Astropan 400 film disc. Film holders may be returned with the film for processing. They are re-usable and subject to refund when returned as explained below. Shipping weight 2 oz.

Cat. No. 651-FFH-4 4 for \$2.00

NEW REFUND PLAN ON FILM HOLDERS

A refund of \$.15 will be allowed for all film holders returned to us in good re-usable condition. When returning film holders for any reason you may deduct \$.15 for each holder returned. Unless you specifically request their return, all holders sent us will be automatically retained and the refund will be made or credit allowed.

FILM ONLY

Precision cut Astropan 400 film discs to fit Camroc film holder. Packaged in light-proof double envelope. Envelope should be opened **ONLY IN TOTAL DARKNESS** to avoid ruining the film. Handling and loading instructions included. Shipping weight 1.5 oz.

Cat. No. 651-NF-6 6 for \$.75

CHANGING BAG

Light-tight "portable darkroom". Fits over operator's arms, provides total darkness for changing film in the field or reloading your own film holders. Shipping weight 8 oz.

40 Cat. No. 651-FCB-1 \$1.25 each



DEVELOPING-PRINTING

Film is developed under controlled conditions. One glossy print is made at 2 times enlargement (3" dia. image). A refund of \$.20 will be made on any negative which does not meet the requirements for a satisfactory print. This can be caused by incorrect exposure or improper handling. In this case negative will be returned unprinted. We recommend sending your film for processing in its original container or other totally light-tight container.

Cat. No. 691-FDP-1 \$.50

EXTRA PRINTS

You can order additional prints of negatives which have been previously developed. The negative(s) must be enclosed in a suitable protective package with the order. (Please do not order extra prints without first checking the negative and original print to determine if it is suitable for extra prints.)

Cat. No. 651-NP-1 \$.30 ea.

Astron

TWO STAGE

DELTA

Reliable workhorse booster for payload research. The Astron Delta accommodates all BT-50 size payload sections. For use with the nose cone or payload section of your choice. May be flown either as a single or two stage vehicle, features advanced stage coupling for top dependability. Kit is complete with all parts and easy-to-follow instructions (nose section and engines not included). Shipping wt. 8 oz. Cat. No. 651-K-16 \$1.50 each

Kit includes technical report TR-2

Learn multi-stage techniques with this versatile research vehicle for payload and altitude tests.



**MULTI PURPOSE
FLIES OVER 2000 FEET
PARACHUTE RECOVERY
ADVANCED DESIGN**

Recommended booster vehicle for the Camroc aerial rocket camera

RECOMMENDED ENGINES FOR REGULAR PAYLOAD USE ONLY.

(See page 38 for engines recommended for use with Camroc.)

Single Stage Flights

A8-3 B6-4
B14-5 B14-6
C6-5

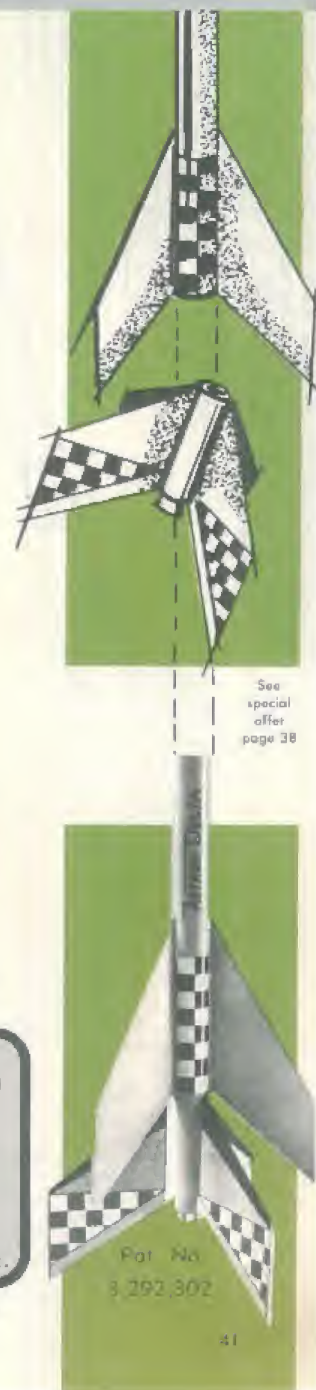
Multi-Stage Flights

Booster	Upper Stage
B6-0	B6-6 B14-6
B14-0	C6-7 B14-7
C6-0	

SPECIFICATIONS

Length 13.6 in., Body Dia. 0.976 in., Weight 1.45 oz.

The basic system used on most multi-stage model rockets today is covered by Estes patent number 3,292,302



See special offer page 38

Pat. No. 3,292,302

**3
STAGES**

Astron FARSIDE

A sophisticated ultra-high altitude probe or a workhorse vehicle for high altitude studies with large payloads—take your choice with the Astron Farside. Advanced stage coupling gives dependable ignition and stage separation. Perfect for your advanced research programs. Top stage flies to well over 2500', returns gently by parachute. Available with standard 1" payload section (No. 651-K-12) or with extra large 1½" dia. capsule for large payloads (No. 651-K-12X). Be sure to specify model type when ordering. Kit comes complete with all parts and assembly instructions (but no engines). Includes technical report TR-2. Shipping weight 8 oz.

LARGE PAYLOAD:

Cat. No. 651-K-12X \$3.00 each

STANDARD MODEL:

Cat. No. 651-K-12 \$2.75 each

Pat. No. 3,292,302

SPECIFICATIONS

	K-12	K-12X
Length	21.5 in.	25 in.
Weight	2.0 oz	2.5 oz
Diameter	0.98 in	1.6 in.

RECOMMENDED ENGINES

First Stage	Second Stage	Top Stage
½ A6-0	½ A6-0	½ A6-4
A8-0	A8-0	A8-5
B14-0	B6-0	B4-6
	B14-0	B6-6
	C6-0	B14-6
		C6-7

NOTE: Other booster engines may be used if there is no wind.

Astron APOGEE II

HIGH ALTITUDE

The highest point in orbit is called "APOGEE"; an appropriate name for this high flying, altitude reaching rocket.

2 STAGE POWER

\$2.00

SEE-THROUGH PAYLOAD

This is the ultimate in 2-stage performance and reliability. Featuring a see through payload capsule to let you observe specimens without removing them from the rocket, soft parachute landings for safe recoveries and revolutionary discoveries in multi-staging, the Astron Apogee II is perfect for research or experimental flights. Comes complete with all parts and instructions, but no engines. Shipping wt. 6 oz.
Cat. No. 651-K-5 \$2.00

Specifications	Recommended Engines	
Weight: 0.60 oz.	Booster	Upper Stage
Length: 14.75 in.	½ A6-0	¼ A3-4
Body dia. 0.736 in.	A8-0	½ A6-4
	B6-0	A5-4
	B14-0	A8-5
	C6-0	B4-6
		B6-6
		B14-7
		C6-7

Pat. No.
3,292,302

Kit includes technical report TR-2

Astron midget

only
\$1.25



TWO STAGE ROCKET

Pat. No. 3,292,302

The **BIG** one
in the **SMALL** package

No midget in performance, this unique 2 stage rocket is designed to get the most out of the smaller series III engines. Graceful in flight and fast at lift-off, the Astron Midget is an exciting design to fly. Upper stage features chute recovery while the booster flutters gently back to earth. Kit contains all parts and instructions (less engines). Shipping wt. 6 oz.

Cat. No. 682-K-40 \$1.25

SPECIFICATIONS

Length 9.25 in.
Body Dia. 0.976 in.
Weight 0.56 oz.

RECOMMENDED ENGINES

Booster 1/2 A6-OS
Upper Stage 1/4 A3-4S
 1/2 A6-4S

Astron AVENGER

TWO
STAGE
POWER



FOR SPORT
OR SHOW

SPECIFICATIONS

Body Dia. 1.325 in.
Length 32 in.
Weight 2.7 oz.

RECOMMENDED ENGINES

Booster	A8-0	B6-0
	B14-0	C6-0
Upper Stage	A5-4	
	B6-6	C6-7

Long slender lines give this bird the appearance of a sounding rocket. Two stage design gives the Astron Avenger high altitude capabilities for sport or demonstration flights. A clean good-looking rocket, it gives great flights and is an impressive addition to your fleet. Large 18" parachute brings payload section back gently, while booster section flutters in softly. Comes complete with all parts, instructions, and TR-2 on staging. (Engines not included) Shipping weight 16 oz. Cat. No. 682-K-38 \$2.75
Pat. No. 3,292,302

Astron CONSTELLATION



**SINGLE STAGE
PAYLOAD ROCKET**

The perfect high performance bird for single stage payload work or just flying for fun. The long slender lines and the "landing shocks" at each fin tip lend the appearance of a space vehicle of the future. Parachute recovery, "see-through" payload section plus a quick change engine mount make the Constellation easy to fly and reliable. Kit comes complete with all parts and instructions (less engines). Shipping weight 6 oz.

Cat. No. 681-K-35 \$2.00

SPECIFICATIONS

Body Dia. 0.976 in.
Length 16.2 in.
Weight 1.0 oz.

RECOMMENDED ENGINES

1/2 A6-2 A8-3 A5-4
B6-4 C6-5

Astron Gyrocopter

**Whirly Bird
Rocket**

**FASCINATING
DESIGN**



**HELICOPTER
RECOVERY**

Excellent performance and amazing recovery system make the unique Gyrocopter a "bird" you'll want to own. Its unusual design gives this rocket the ability to reach high altitudes and return safely with helicopter recovery for minimum drift with wind. Comes complete with all instructions and parts. Engines not included. Shipping weight 5 oz. Cat. No. 671-K-24 \$1.25

Specifications

Weight 0.58 oz.
Body Dia. 0.736 in.
Length 9.8 in.

Recommended Engines

1/2 A6-2 A8-3
B6-4 C6-5

LOW WIND DRIFT



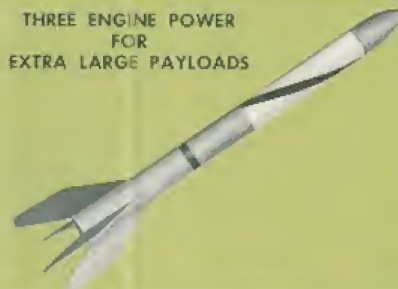
ALWAYS A WINNER

SPACE PLANE

A historic duration winner and record holder, the Space Plane is one of the most successful boost-gliders ever developed. Ascends vertically under rocket power, then glides safely back to earth. The Space Plane gives unlimited flying enjoyment. Features accurate glide adjustments plus a payload section for small specimens. Recommended for the experienced modeler. (kit includes TR-4, but no engines). Shipping wt. 5 oz. **Cat No. 651-K-3 \$1.80**

BODY DIA.	7.65 in.	RECOMMENDED ENGINES
LENGTH	10 in.	1/2A5-2 A5-2 B4-2
WG. SPAN	9 in.	(use 1/2A engines for first flight)
WEIGHT	0.5 oz.	

THREE ENGINE POWER
FOR
EXTRA LARGE PAYLOADS



RANGER

Lift those BIG payloads off the pad with the powerful Astron RANGER. Perfect for launching and recovering those special instruments and specimens. The RANGER comes with all parts and instructions, plus TR-6 report on clustering. (less engines). Shipping wt. 13 oz. **Cat. No. 651-K-6 \$2.75**

BODY DIA.	1.6 in.	RECOMMENDED ENGINES
LENGTH	24 in.	A8-3 B6-4 C6-5
WEIGHT	3.35 oz.	(use B6-4 engine for first flight)



CONTROVERSIAL
UNIQUE DESIGN

SPACEMAN

Great for demonstrating that a rocket doesn't always have to look like a rocket to fly well. Requires a little patience and artistic ability to build. Uses the featherweight recovery system. Complete kit and instructions (less engines). Shipping wt. 7 oz. **Cat. No. 651-K-9 \$.75**

WIDTH	4 in.	RECOMMENDED ENGINES
LENGTH	7.25 in.	1/2A5-2, A5-4, B4-4, B6-5
WEIGHT	0.45 oz.	C6-7, (use 1/2A5-2 in first flight)



THREE ENGINE BOOST
FOR
COMPACT PAYLOADS

COBRA

Ideal for your first cluster bird. The Astron Cobra gives you top performance with medium size payloads (to 4 oz.) in a 1" dia. capsule. . . . complete kit and instructions plus the TR-6 report on cluster techniques. (less engines) Shipping wt. 13 oz. **Cat. No. 651-K-10 \$2.50**

BODY DIA.	1.6 in.	RECOMMENDED ENGINES
LENGTH	22.25 in.	A8-3 B6-4 C6-5
WEIGHT	2.5 oz.	(use B6-4 engine for first flight)

Welcome to the exciting world of model rocketry! This brief technical manual for model rocketeers was written to provide both an easy to-follow guide for the beginner and a handy reference volume for the experienced rocketeer. In the next few pages you'll find the answers to the questions most commonly asked by model rocketeers. More complete technical information on all the subjects covered can be found in the many publications listed in the current Estes catalog.

We hope this manual will help make model rocketry as exciting and enjoyable for you as it is for us.



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Prepared by the Estes Staff
William Simon Editor
Gene Street Illustrator

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YOUR FIRST ROCKET

BUILDING THE ASTRON ALPHA A TYPICAL MODEL ROCKET

The construction of the Astron Alpha is shown here both to give the beginning rocketeer plans for a good first model and to illustrate the way a typical model rocket is built. The assembly techniques used in this and other model rockets are explained in greater detail on the following pages.

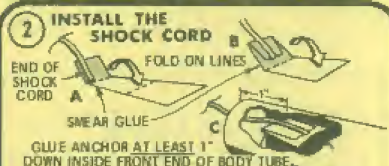
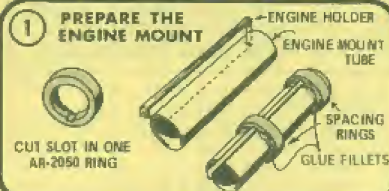
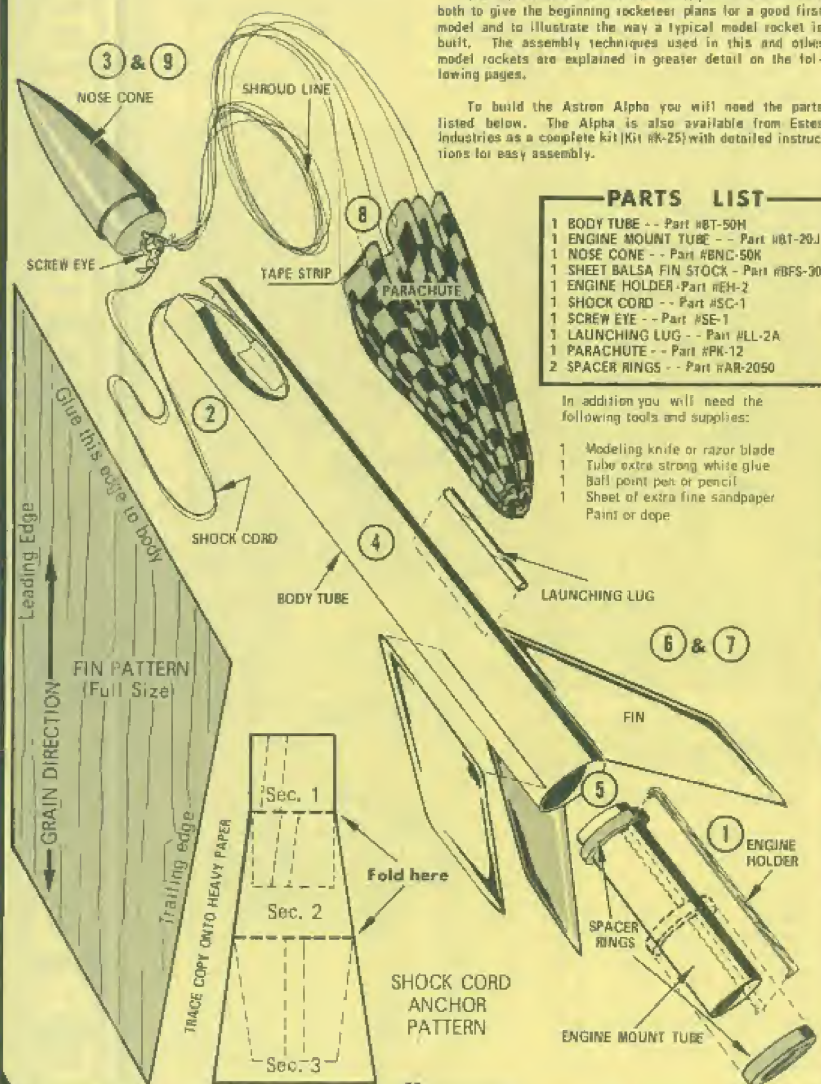
To build the Astron Alpha you will need the parts listed below. The Alpha is also available from Estes Industries as a complete kit (Kit #K-25) with detailed instructions for easy assembly.

PARTS LIST

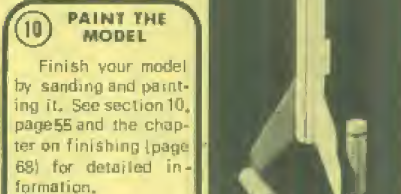
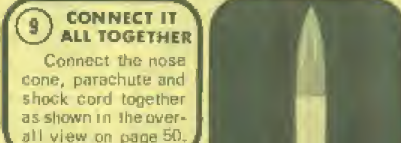
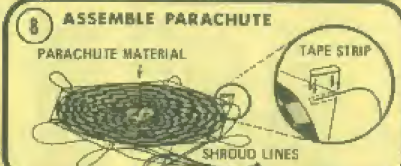
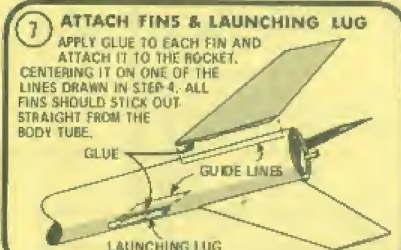
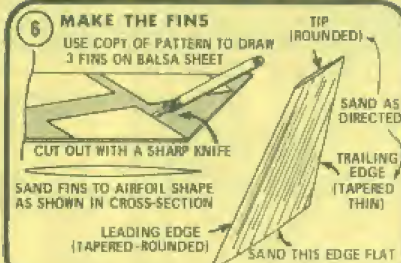
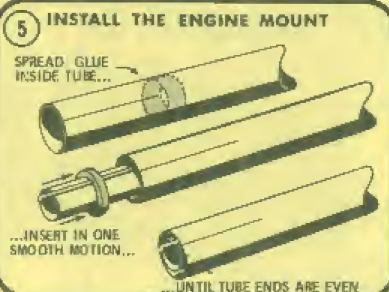
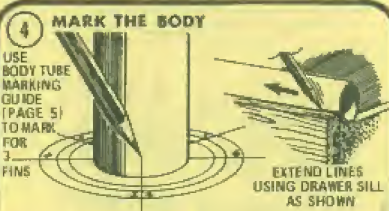
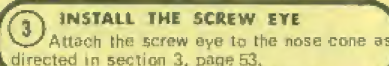
- 1 BODY TUBE -- Part #BT-50M
- 1 ENGINE MOUNT TUBE -- Part #ET-20J
- 1 NOSE CONE -- Part #NC-50K
- 1 SHEET BALSA FIN STOCK -- Part #BFS-30
- 1 ENGINE HOLDER -- Part #EH-2
- 1 SHOCK CORD -- Part #SC-1
- 1 SCREW EYE -- Part #SE-1
- 1 LAUNCHING LUG -- Part #LL-2A
- 1 PARACHUTE -- Part #PK-12
- 2 SPACER RINGS -- Part #AR-2050

In addition you will need the following tools and supplies:

- 1 Modeling knife or razor blade
- 1 Tube extra strong white glue
- 1 Ball point pen or pencil
- 1 Sheet of extra fine sandpaper
- Paint or dope



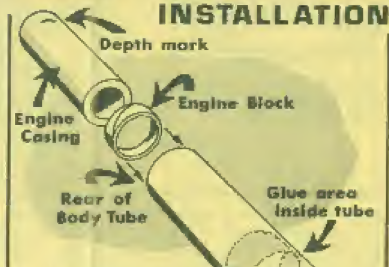
To absorb the shock of ejection and parachute opening a rubber cord connects the parachute and nose cone to the main rocket body. This shock cord must be securely attached to the body with an anchor as shown.



CONSTRUCTION TECHNIQUES

① ENGINE MOUNTING METHODS

ENGINE BLOCK INSTALLATION



Some models use an engine block to keep the engine from traveling too far forward in the rocket body both when it is installed and when the rocket is launched.

When building a model, use an engine casing to press the engine block into position. After applying glue to the inside of the

tube, place the engine block just inside the rear of the body. Push the block forward into position with the engine casing in one smooth motion so the glue will not freeze the block in the wrong place.

When the mark on the engine casing is even with the rear of the body tube the block will then be in the correct position. Remove the engine casing immediately.

FRICTION FIT



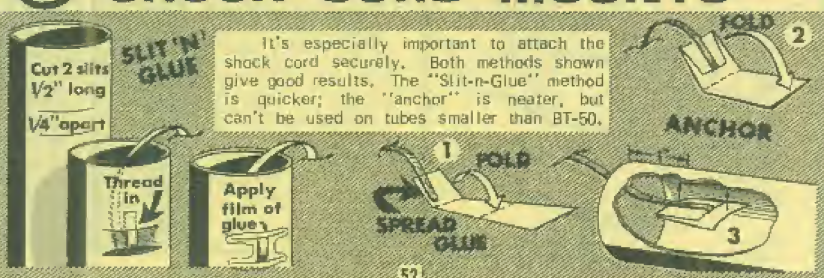
When mounting the engine in a model with an engine block, wrap the engine with masking tape until it will make a tight friction fit in the tube. Then slide the engine into place.

ENGINE HOLDERS

In many models an engine holder is the best device to use for mounting an engine. The drawings show how engine holders are mounted for different sizes of rockets.



② SHOCK CORD MOUNTS

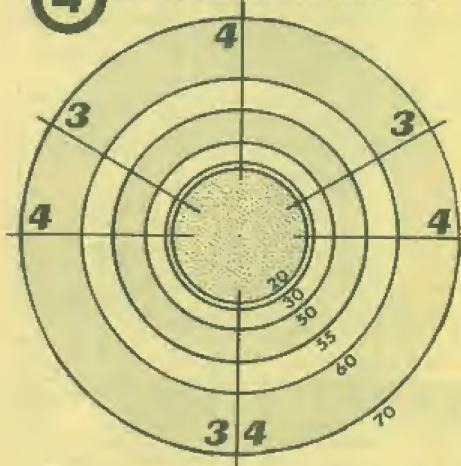


③ SECURING A SCREW EYE

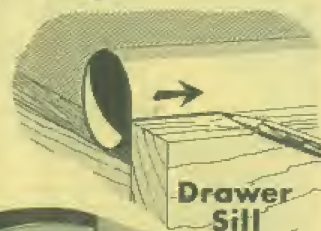
To avoid losing your nose cone, make sure the screw eye is securely attached. Make a hole by inserting and removing the eye. Squirt glue into the hole and replace the eye.



④ MARK THE BODY



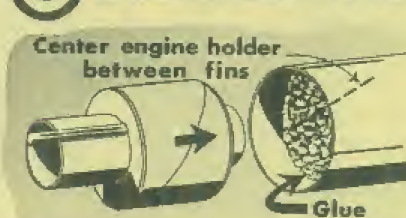
When marking the body tube for fin alignment, use the "V" notch of a drawer sill or door frame as shown. Match the edge of the notch with a spacing mark; run a pencil along the edge to draw your guide line. When all three or four lines are drawn, glue the fins to the body on the lines and they will be straight.



This Fin Spacing Guide will space equally three or four fins on all popular body tubes sold by Estes Industries. To space the fins, center the end of the tube in the circles, then mark at the (4) lines for four fins or on the (3) lines for three fins. Draw lines from these marks as shown in the drawings at right.



⑤ INSTALL THE ENGINE MOUNT



It's best to draw the fin alignment lines on the body *before* installing the engine mount. Position the mount so the engine holder is midway between two fin lines for easier operation. First make sure the mount slides easily in the body tube. If it's tight, sand it until it does slide easily. Spread a liberal amount of glue around the inside of the body over the area where the mount's rings or coupler will fit. Insert the mount into position in one smooth motion. DON'T pause, or the glue will "grab" with it in the wrong place. Support the tube "nose-up" while the glue dries.

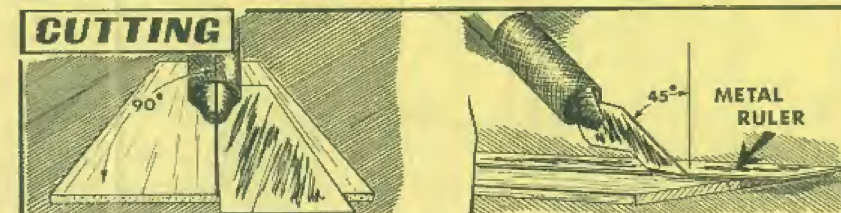
⑥ MAKE THE FINS MARKING



Model rocket fins are almost always made from thin sheets of balsa wood. When making fins, always be sure the grain of the wood is *parallel* to the leading edge of the fin.

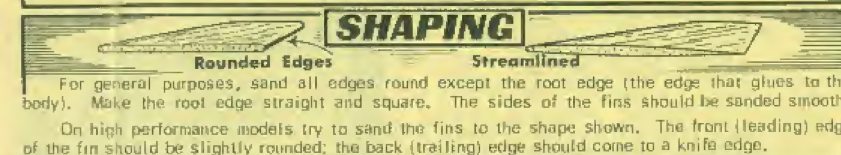
Draw a full-size fin pattern on stiff paper or cardboard. Cut out the pattern, position it on the fin stock, and trace around it with a pencil or ball point pen to mark the balsa for each fin.

CUTTING



Use a metal straightedge whenever possible. Hold knife or saw blade at 90° angle to surface being cut, & handle at about 45° for clean cut. If blade is dull or held too high balsa tends to tear.

SHAPING



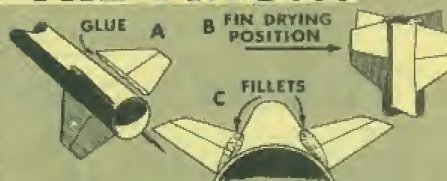
For general purposes, sand all edges round except the root edge (the edge that glues to the body). Make the root edge straight and square. The sides of the fins should be sanded smooth.

On high performance models try to sand the fins to the shape shown. The front (leading) edge of the fin should be slightly rounded; the back (trailing) edge should come to a knife edge.

⑦ ATTACHING THE FINS...

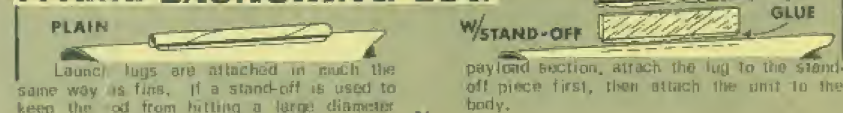
Always use a high-strength adhesive such as white glue for attaching fins. After marking the tube and sanding the fins, apply a line of glue to the root edge of a fin. Let it set a minute or two, then press it into place on the body tube. Attach the other fins in the same way. Support the rocket body in a vertical position while the glue dries.

Sometime after the first glue on the fins has dried completely, the joints should be



reinforced. Do this by applying a "fillet" of glue as shown. Always support the body in a horizontal position while fillets are drying.

...and LAUNCHING LUG



Launch lugs are attached in much the same way as fins. If a stand-off is used to keep the rod from hitting a large diameter

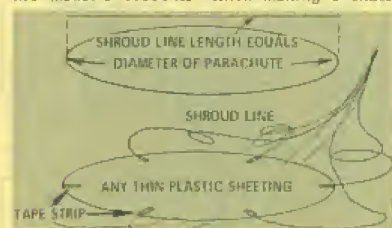
payload section, attach the lug to the stand-off piece first, then attach the unit to the body.

⑧ ASSEMBLE PARACHUTE

In addition to regular, pre-printed model rocket parachutes, a rocketeer can use a wide variety of thin plastic sheeting to slow his model's descent. When making a chute

it's often worthwhile to be able to quickly switch a parachute from one model to another or to replace a 'chute with a new one.

To install a snap swivel, simply gather the ends of the shroud lines and dampen them so as to form a fairly stiff "point," then thread this point through the eye of the snap

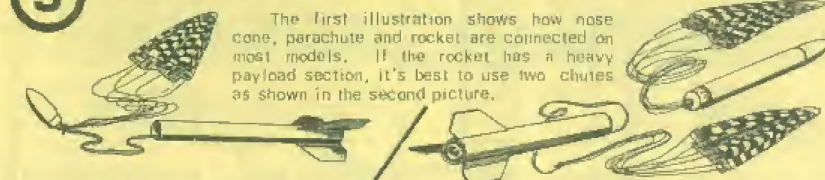


from "scratch," cut the plastic sheet to shape, then attach 6 or 8 shroud lines, each as long as the diameter of the parachute, as shown. Gather all the loose ends of the shroud lines and tie a knot at the extreme end of the group.



swivel as shown. Once through the eye the lines are tied together in a tight knot and pulled back against the eye. Apply a drop of glue to the knot.

⑨ CONNECTING IT TOGETHER



The first illustration shows how nose cone, parachute and rocket are connected on most models. If the rocket has a heavy payload section, it's best to use two chutes as shown in the second picture.

⑩ PAINT THE MODEL

Nothing does quite as much for the appearance of a model as a good paint job. Before the paint can go on, though, a lot of careful preparation should be done.



Make sure all glue fillets are smooth and have no air holes. If a fillet isn't right, apply another layer of glue and smooth it out with your finger tip.

WOOD SEALING

All balsa surfaces should be "filled." To do this, apply a coat of sanding sealer, let dry completely, and sand with extra-fine (or finer) sandpaper. Apply another coat, let dry, and sand again. Continue this procedure until all the tiny holes (pores) in

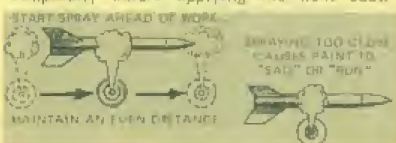
the wood are filled and the surface is perfectly smooth.

BRUSH-ON PAINTS

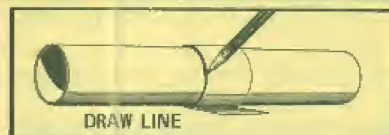
If you use a brush, make sure the brush is clean. Old dope will mix with and discolor fresh dope. Dope can be thinned 50% for a smoother finish. Avoid "brushing over" as the surface sets rapidly. Unnecessary brushing can produce an uneven finish. Always let the paint dry completely between coats.

SPRAYING...

Spray paints will give the beginner a better than average finish. Apply spray paint in light, even coats. Let each coat dry completely before applying the next coat.



Many models call for special lengths of body tubes; the rocketeer has to cut the tube himself to build the rocket. Here's how to get a neat cut every time.



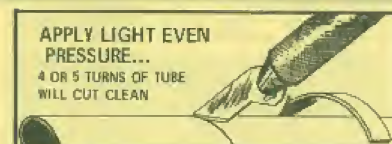
(1) Mark the tube at the point where the cut is to be made. Wrap a straight strip of paper around the tube and align the edge with the mark. Draw a line completely around the tube.



(2) Slide a stage coupler into the tube—center it under the cut position to support the tube.

(3) Cut lightly along the line, rotating the tube as you cut. Use a sharp blade but

CUTTING TUBES



don't try to cut all the way through on the first turn. Use a light pressure on the knife for several turns until you cut through.

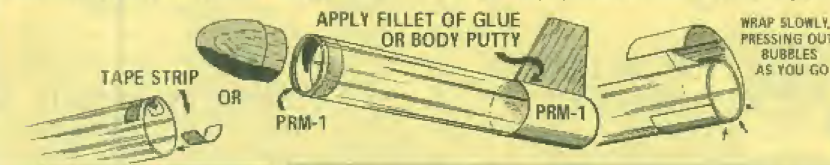


(4) Slide the stage coupler into the cut end of the tube. Hold the tube near the cut end and work it over a flat sheet of very fine sandpaper with a circular motion as shown to remove burrs and rough edges.

MYLAR BODIES

BT-10 is an ultra-light mylar plastic tube which is recommended for use with the featherweight recovery system. It will withstand the heat of an ejection charge only

when the engine is ejected from the rocket body by the charge. Paper reinforcing material must be used to glue parts to the tube, as ordinary glues will not stick to mylar.



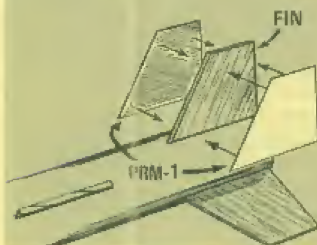
WRAP SLOWLY, PRESSING OUT BUBBLES AS YOU GO

REINFORCING FINS

When a model is built to be flown many times, it's often wise to strengthen the fins. The easiest way of doing this is to use self-adhesive paper reinforcing material (PRM-1).

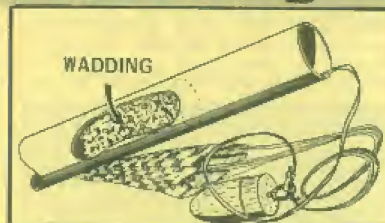
Cut out two "mirror-image" pieces of reinforcing material for each fin. Peel off the backing and apply one piece to each side of the fin. Rub the reinforcing down on both sides so it is securely attached, then seal around the edges with white glue.

Fins reinforced in this manner give up to four times the strength of plain balsa wood with only a little more weight.

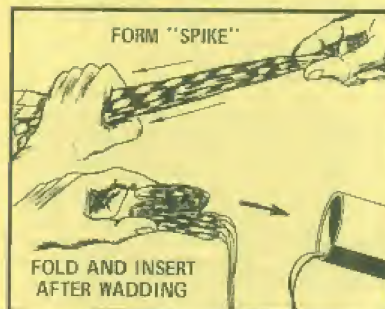


FLYING YOUR MODEL

Preparing for Flight

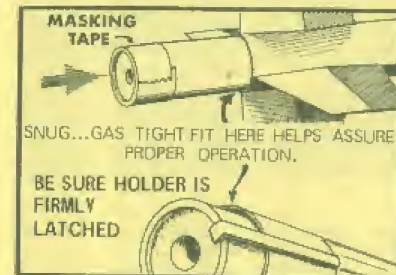


Parachutes and streamers must be protected from the heat of the ejection charge. This protection is supplied by first loosely packing enough flameproof recovery wadding into the tube to fill it for a depth of at least twice the body diameter. The wadding should fit against the side of the tube all the way around to give a good seal.



To fold the parachute, hold it between two fingers at its center and pass the other hand down it to form a "spike" shape. Fold this spike tightly into several sections as shown. Push the folded chute down into the tube on top of the wadding. Pack shroud lines and shock cord in on top of the chute, then slide the nose cone into place.

To activate streamer or parachute recovery gear correctly, the engine **MUST** be held in place **SECURELY**. This may be done by wrapping the nozzle end of the engine with tape until it makes a snug fit in the body tube or engine mount.



On models using engine holders, make sure the end of the holder latches securely over the end of the engine.

Countdown Checklist

Use a countdown check list when you launch your models. You'll find it makes your rocket flights more successful and enjoyable. The following procedure is recommended for most chute or streamer models. For other types of rockets, try to develop your own complete check list.

12) Pack flameproof recovery wadding into the body tube. Insert the parachute or streamer.

11) Install the nose cone or payload section. Check condition of the payload (if any).

10) Apply enough masking tape to the engine(s) for a tight friction fit in the body tube(s). When launching a multi-stage rocket

be sure that the engines are in their proper relative positions and that a layer of cellophane tape is wrapped tightly around each engine joint. Mount the engine in the rocket.

9) Install a nichrome igniter in the engine.

8) Place the rocket on the launcher. Clean and attach the micro-clips.

7) Clear the area, check for low flying aircraft, alert recovery crew and trackers.

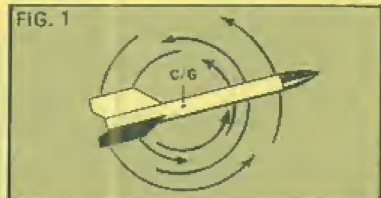
6) Arm the launch panel.

5) 4) 3) 2) 1) LAUNCH!

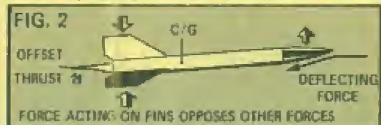
STABILITY

One of the first things a model rocket designer learns is that a vehicle will not fly unless it is *aerodynamically stable*. By stable we mean that it will tend to keep its nose pointed in the same direction throughout its upward flight. Good aerodynamic stability will keep the rocket on a true flight path even though some force (such as an off-center engine) tries to turn the model off course.

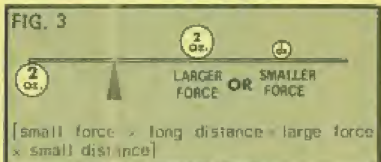
If a model is not stable, it will constantly turn its nose away from the intended flight path. As a result, it will try to go all over the sky, but end up going "nowhere." An unstable rocket will usually tumble to earth after the engine burns out, damaging the model.



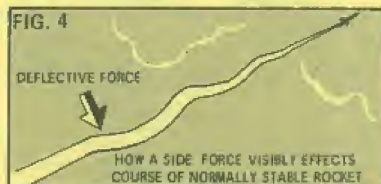
When a free-flying object rotates, it always rotates around its balance point. (The proper term for the balance point is the *center of gravity*, abbreviated as C.G.) Thus the balance point (C.G.) is the pivot for all forces trying to turn the rocket.



The most significant forces acting on a model rocket in flight are caused by the thrust of the engine, the action of air on the nose and the action of air on the fins. Off-center thrust and the forces on the nose try to bring the nose of the rocket around to the rear. They are opposed by the forces acting on the fins. All these forces are amplified by the distance from the location of the force to the center of gravity.

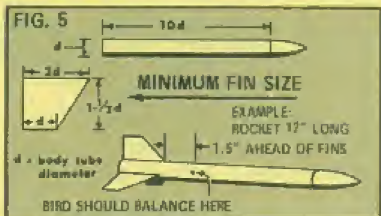


As long as the forces on the fins of the rocket are great enough to counteract the forces on the nose and any off-center thrust, the rocket will fly straight. If the fins are too small and/or too close to the center of gravity, there will not be enough force to counteract the force on the nose. As a result, the nose will swing out to the side and the model will try to chase itself around the sky.



The side forces on the nose and fins of a rocket that is flying straight are very small. When something disturbs the rocket and it starts to turn sideways, the side forces on both nose and tail increase. (There is some aerodynamic force on the body; however, it is small and can usually be ignored.) Depending on the size and shape of the nose and fins and their distances to the center of gravity, one will overpower the other and force the rocket to turn its way. If the nose overpowers the fins, it's too bad. However, if the fins overpower the nose, the rocket will swing back into line and continue on its way.

Although determining the exact relationships between various forces on a model rocket requires higher mathematics, certain practical rules can be used by even the beginning rocketeer to design stable rockets. The first rule is to use a long body. Until you have considerable experience in designing models, the length of the body tube used should be at least 10 times its diameter. This makes it easier to get enough distance between the center of gravity and the fins.



The second rule is to make the fins large. The larger the fins, the more force they will produce when the rocket starts to turn. For the first few designs, use a fin which is at least as large as the example in the illustration.

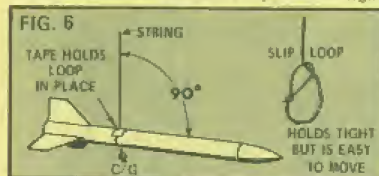
The third rule is to place the fins as far back on the rocket as possible. Generally, this means that the rear edge of the fin will meet the rear end of the body and the fin will be swept back. Do not place any fins ahead of the center of gravity.

Finally, the rocket should balance at least 1/8 its length ahead of the front of the fins. This gives the fins the leverage they will need to counteract the force on the nose.

Remember that these rules are general; they are based on experience rather than precise mathematical analysis. By using more exact methods (See TR-1 and TR-9) it's possible to build rockets with less stability margin. In any event, always remember to test your model for stability before you launch it.

Testing for Stability

The easiest way of testing the stability of a model is to fly it—without launching it. This is done by attaching a string to the model and swinging it through the air. If the string is attached at the rocket's C.G., its behavior as it is swung through the air will indicate what it will do in powered flight.

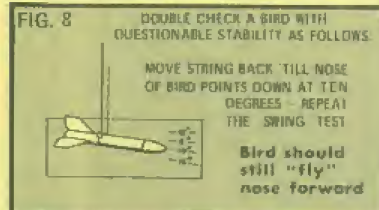


Make the test on your model by forming a loop in the end of a six to ten foot string. Install an engine in the rocket. (The center of gravity is always determined with an engine in place.) Slide the loop to the proper position around the rocket so the model balances horizontally. Apply a small piece of tape to hold the string in place.



With the rocket suspended at its center of gravity, swing it overhead in a circular path. If the rocket is very stable, it will point forward into the wind created by its own motion. Some rockets which are stable will not point forward of their own accord unless

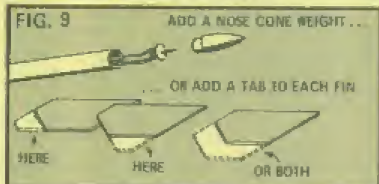
they are started straight. This is done by holding the rocket in one hand with the arm extended and then pivoting the entire body as the rocket is started in the circular path. It may take several attempts before a good start is achieved.



If it is necessary to hold the rocket to start it, an additional test should be made to determine whether the model is stable enough to fly. Move the loop back on the body until the tube points down at a 10° angle below the horizontal. Repeat the swing test. If the model will keep its nose pointed ahead once started, it should be stable enough to launch.

Be careful when swinging a rocket overhead: A collision with a nearby object or person could be serious. Always do your testing in an open, uncluttered area.

Don't try to fly a rocket that has not passed the test. Most unstable rockets loop around in the air harmlessly. However, a few marginally unstable models will make a couple of loops and then become stable due to the lessening of the propellant load. When this happens, the model can crash into the ground at high speed. A person standing in the wrong place could get hurt.



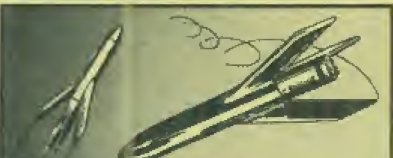
If your rocket does not pass the stability test, it can usually be made stable. Two methods can be used: The balance point can be moved forward or the fins can be enlarged. To move the balance point forward, attach nose cone weights to the base of the nose cone. Fins can either be replaced with larger ones or extra tabs can be glued to the rear or tip edges of the fins. (Some scale models use supplementary plastic fins.) After making your changes, test the model again to be sure it is now stable.

RECOVERY SYSTEMS

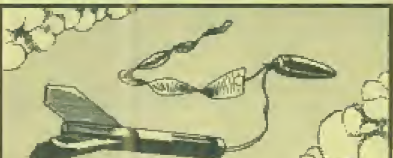
The recovery system is one of the most important parts of a model rocket. It is designed to provide a safe means of returning the rocket and its payload to earth without damaging the rocket or presenting a hazard to persons on the ground. Also, the recovery system provides an area for competition when rocketeers hold contests to see whose rocket can remain aloft the longest. In addition,



1. Featherweight Recovery (i.e. Astron Streak): The model is designed for extra light weight (under 1/4 ounce) without engine and has a blunt nose. When the engine is ejected from the rocket, the model is so light compared to its size that it lands safely. The lightweight, aerodynamically unstable, spent engine casing tumbles back separately.



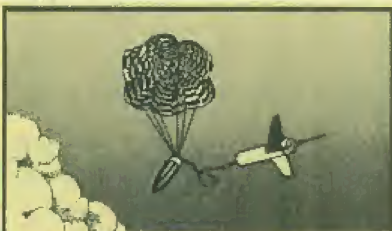
2. Tumble Recovery (i.e. Astron Scout, Sprite): The ejection charge shifts the weight of the engine in the rocket rearward. This makes the rocket unstable. With the balance point of the rocket further toward the rear, air pressures ahead of the balance point are greater than behind, forcing the rocket to start tumbling. When the rocket is tumbling, air drag on it is much higher and it falls slowly. Estes Pat. No. 3,114,317



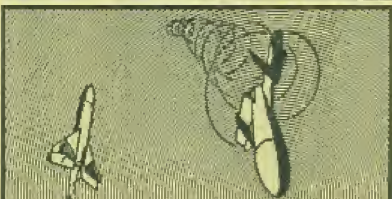
3. Streamer Recovery (i.e. Astron Mark): A model with a small streamer will act like a tumble model. If the streamer is large enough, it develops enough drag by fluttering to actually hold the rocket back in its descent and it lands gently.

rocket recovery is an area for valuable experimentation and research as rocketeers develop new and better methods of returning their models to earth or study air currents.

Most recovery systems in use today depend on drag (or wind resistance) to slow the rocket. Each changes the model from a streamlined object to one which the air can "catch against" and retard its descent. Six main recovery methods are used by model rocketeers today. Following is a brief description of each:



4. Parachute Recovery (i.e. Astron Alpha): The ejection charge forces a parachute connected to the model out of its body tube. The parachute deploys, filling with air, and supports the model on its return.



5. Helicopter Recovery (i.e. Astron Gyrod): Vanes on the model, activated by the ejection charge, catch the air in a way that makes them spin on the way down. The spinning vanes disturb the flow of air past the rocket creating a large amount of drag.



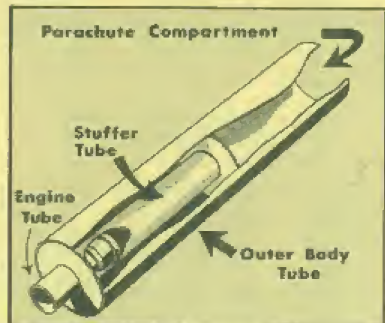
6. Glide Recovery (i.e. Astron Falcon, Nighthawk): The model ascends vertically like a conventional rocket. At ejection either the balance of the model or the position of its aerodynamic surfaces is changed. Instead of streamlining straight down, the wings generate lift, pulling the nose up, and the model goes into a glide. Models of this type are called "Boost-gliders". Estes Pat. No. 3,157,960. Other pat. pending.

No rocketeer likes to see the product of many hours' labor broken because the recovery system didn't work properly. Recovery failures are almost always due to an error in building the model or in preparing it for flight.

The most common error on parachute and streamer models is failing to install the engine properly. If the engine is not held securely, it will be ejected instead of the streamer or parachute. On models with engine holder hooks, make sure the hook latches properly over the end of the engine. If the model relies on a friction fit to hold the engine, wrap enough masking tape around the engine to make it fit tightly.

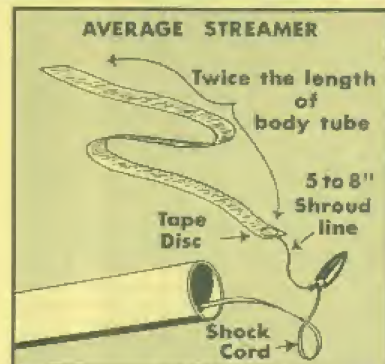


A second error is leaving a hole that ejection gasses can leak through. Incorrect engine mount design or construction is often the villain. For reliable recovery the rear of the rocket must be air tight when an engine is in place.



Recovery reliability on extra-large models can be improved by using a stuffer tube. This reduces the volume that the ejection charge must pressurize, resulting in more force to eject the nose cone and chute. A stuffer usually is made from BT-20 or BT-50 body tube, centered inside the model's body, with paper rings glued on each end. The rings should also be glued to the inside of the body so there is no gas leakage into the space between the stuffer and outer body tube.

Reliable Recovery



For high altitude models parachute recovery is often too good; the bird can be miles away by the time it finally touches down. Streamer recovery is often the answer. A strip of 1" wide flameproof crepe paper, usually at least twice as long as the rocket itself, will supply enough drag at the nose to make the rocket fall sideways. In this condition it falls enough faster than with a parachute to bring it back close to the launch area. It falls slow enough, however, to avoid damaging the model.



Whether the model has a parachute or streamer, always be sure to use enough flameproof wadding. The wadding not only serves as an insulating layer between the hot ejection gasses and the chute or streamer; it also works as a gas seal and piston to insure that the ejection charge works evenly against the recovery device. Wadding should be loosely packed, filling the entire area of the tube for a distance equal to twice its diameter.

By following these suggestions, you'll find you get many more successful flights. Not only will your models last longer, but you'll also find that reliable recovery makes model rocketry more enjoyable.

MULTI-STAGING

Ignition

The first stage of a multi-stage rocket is always ignited by standard electrical means. Second stage ignition occurs automatically upon burnout of the first stage. Figure 1A



shows that the first stage engine has no delay or ejection charge. This gives instant ignition of the next stage at burnout.



In figure 1B the propellant is partially burned, leaving a large combustion chamber. As the propellant continues to burn, the wall of propellant becomes thinner until it cannot withstand the high pressure inside the chamber. At this point the remaining propellant wall ruptures, and the high pressure exhausts forward toward the nozzle of the next stage, carrying hot gases and small pieces of burning propellant into the nozzle of the second stage engine. This action is illustrated in figure 1C.



For this system to work, the stages must be held together until the upper stage engine has ignited. When this happens, the stages must then separate in a straight line. This is accomplished by wrapping one layer of cellophane tape around the joint between engines and then recessing this joint 1/2" rearward in the booster body tube, as in fig. 2. Recessing the joint forces the stages to separate in a straight line.

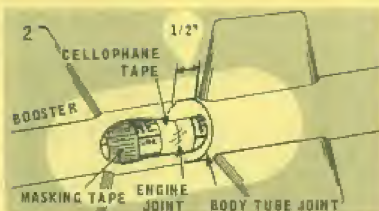
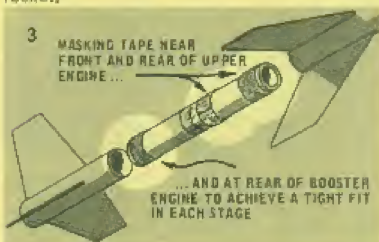
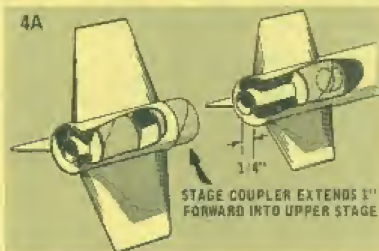


Figure 2 shows the engine installation in a typical two-stage model. Always tape the engines together before inserting them into the rocket. Check carefully before and after taping to be sure the engines are in their proper positions (nozzle of upper stage engine against top end of booster engine). Failure to check carefully can be highly embarrassing as well as damaging to the rocket.

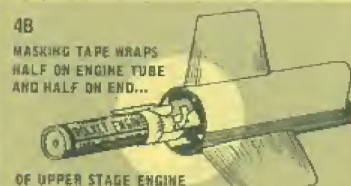


After taping the engines together, wrap masking tape around the upper stage engine at the front and near the rear as in fig. 3 to give it a tight fit in the body. Push it into place. Wrap the booster engine and push it into position. Failure to get the upper stage engine in place tightly enough will result in the recovery system malfunctioning; failure to secure the booster stage tightly can result in its dropping off under acceleration.

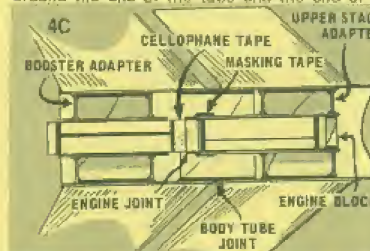


Rockets using large diameter tubes (BT-50 and BT-60) require somewhat different methods, but the same principles of tight coupling and straight line separation must be followed. The recommended coupling

method for large diameter tubes is illustrated in fig. 4. The stage coupler is glued to the booster body tube, with the adapter for the upper stage engine mount positioned forward to allow the stage coupler to fit into the upper stage, while the tube adapter in the booster is positioned to the rear.



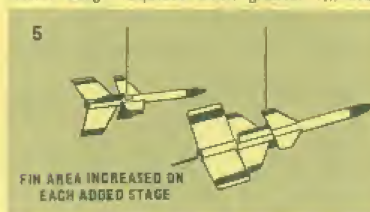
The upper stage engine holder tube projects 1/4" rearward from the end of the upper body tube. The engine is held in place by wrapping a layer of masking tape tightly around the end of the tube and the end of the



engine as in fig. 4B. The engine mount in the booster must be built to leave space for this system (see fig. 4C).

Stability

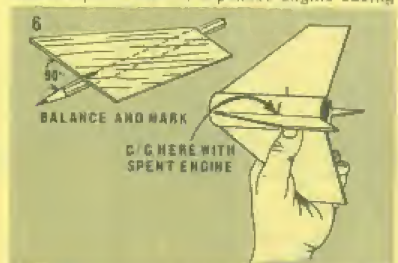
Since two or more engines are mounted near the rear of a multi-stage rocket, it has a tendency to be tail-heavy. To compensate for this, extra large fins are used on lower stage. Generally, the lower set of fins on a two-stage rocket should have two to three times the area of the upper set. Each additional stage requires even greater fin area.



When checking for stability, test first the upper stage alone, then add the next lower stage and test, and so on. In this way you can be sure that the rocket will be stable in each step of its flight, and you can locate any stage which does not have sufficient fin area. Always check for stability with the largest engines to be used in place.

Booster Recovery

Most lower stages are designed to be unstable after separation. The booster should be built so that the center of the area of the fin (its balance point) matches or is up to 1/4" ahead of the booster's balance point with an expended engine casing



in place. Thus, boosters will require no parachute or streamer, but will normally tumble, flutter or glide back to the ground. If the booster is to be used again, it should be painted an especially bright color, as it does not have a parachute or streamer to aid in spotting it once it is on the ground.

Types of Engines

Lower and intermediate stages always use engines which have no delay and tracking charge, and no parachute ejection charge. There is no delay so that the next stage will receive the maximum velocity from its booster. The engines which are suitable are those which have designations ending in zero, such as the A8-0, B6-0, 1/2A6-0S, and B14-0.

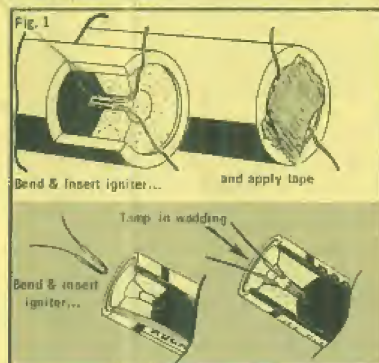
In the upper stage an engine with a delay and tracking charge and parachute ejection charge is used. As a general rule the longest possible delay should be used. Engines suitable for upper stage use are those with long delays such as the B6-6, A8-5, C6-7, etc.

LAUNCHING

Model rockets, like professional rockets, are launched electrically. This provides both safety and realism. Each engine sold by Estes Industries is supplied with an igniter and complete instructions; still more information is supplied with launcher kits. However, the basic information needed to launch models successfully is included in these pages.

Igniter Installation

Estes igniters are supplied in strips of three. Cut the igniters apart (scissors will work) midway between the coated sections. Bend the igniter at the middle as shown and push it into the engine as far as it will go. To operate properly the igniter must touch the propellant grain. Spread the leads and apply a square of masking tape to the nozzle and leads as shown in Fig. 1. The eraser on the end of a pencil is good for pressing the tape securely into place.



An igniter can also be held in place by rolling a 1" square of flameproof wadding into a ball and inserting it into the nozzle with a pen or pencil to hold the igniter firmly in place.

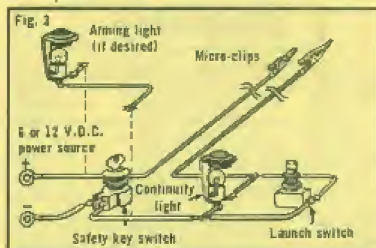
Electrical Systems

The electrical system which operates the igniter can be made in many ways. It can be a simple home-made unit, as the one shown in Fig. 2, or it can be one of the more complete systems sold by Estes Industries.

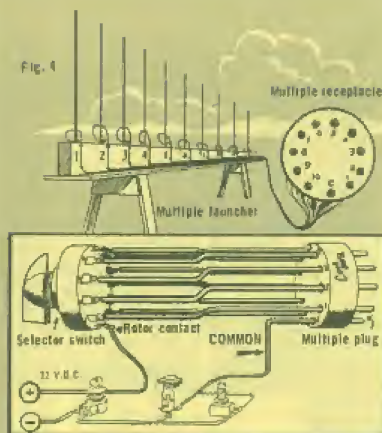


All of these systems work by passing enough electrical current through the high-resistance igniter to heat it to 1100°F. This ignites the coating on the igniter which in turn ignites the engine. The system is attached to the igniter with micro-clips as shown. When connecting the micro-clips to the igniter make sure the clips do not touch each other or the rod or blast deflector. If they do touch, the current from the battery will "short" through the clips, rod or deflector and not reach the igniter.

Any electrical system must have a spring-return launch switch so the current turns off automatically when the button is released. In addition a safety disconnect must be provided. On simple systems the battery clips should be disconnected when the micro-clips are being attached to the igniter. More complete systems may have safety key switches or safety plugs to do the same job.



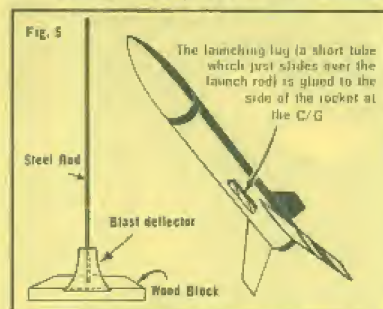
The circuit shown in Fig. 3 also includes a continuity check pilot light. This is a small bulb (no more than ¼ ampere for safety) which lights when the safety interlock is closed if the clips make good connections at both the battery and the igniter. When lit, it indicates that the rocket can be launched.



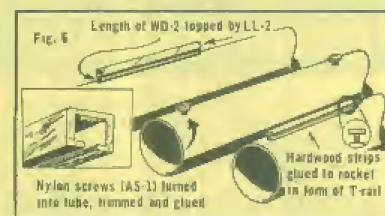
Most rocket clubs prefer a multiple launcher system for group launchings. The basic electrical circuit can be adapted by adding a rotary "pad selector" switch as shown in Fig. 4. Each launch pad then has one micro-clip which is connected to the "common" line to the battery and one micro-clip which is connected to one of the individual terminals on the selector switch.

Launcher Design

A rocket cannot be simply set on its fins and launched; some method of holding it in position before ignition and guiding it during the first few feet of its flight is necessary. The launcher must perform these functions.



The simplest suitable launcher design uses a wood block to support a 36" long, 1/8" diameter steel rod. A short tube, slightly larger than the rod, is glued to the side of the rocket near its balance point. This tube slips easily over the rod and keeps the rocket pointed in the right direction. Fig. 5 shows a rod launching system.



Some launching guides are designed to fit around the lug instead of inside it. The "C" rail is typical of these. Rails generally have the advantage of being stronger and more rigid than rods. However, most model rockets will fly very well with either system. Fig. 6 illustrates a rail and some lugs to fit.

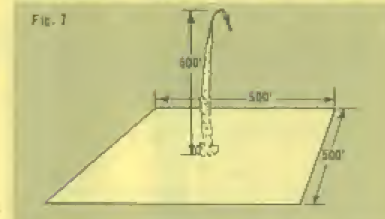
When building a launcher be sure to use a base that is big enough and heavy enough to provide a secure foundation. A piece of 3/4" plywood a foot square works well for most rockets. Bricks or rocks can be used to weight the base when extra-large models are being launched.

Safety

Make sure the area around the launcher is clear and has no dry weeds or highly flammable materials. When approaching the launcher to mount a rocket or check it, put your hand on the end of the rod before leaning over. This helps protect you against the possibility of eye injury from the rod.

Launch Areas

The best place to fly models is on a model rocket range. Many such ranges have been set up by organized groups of rocket enthusiasts. However, if such a range is

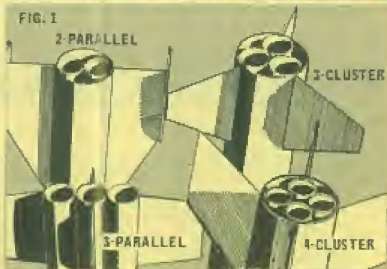


not available, it is best to select a place, free of trees and houses, large enough to recover the rocket within the area. Generally the field should be at least 300 to 500 feet on a side. Set the launcher at the center of the area as shown in Fig. 7.

CLUSTERING

When large models and heavy payloads have to be launched, one engine often cannot supply enough power. A cluster of several engines is generally the answer to this problem.

ENGINE ARRANGEMENTS



In designing a clustered model the first rule to remember is that thrust must be balanced around the centerline of the rocket. Figure 1 shows several engine arrangements that satisfy this requirement. All engines should be located close together to keep unbalanced thrust from forcing the model off course.

ENGINE MOUNTING

The engine mounting system serves three purposes: First, it holds the engines securely in place throughout the flight. Second, it aligns the engines so they work together as a unit and give a straight flight. Finally, it must seal the rear of the rocket so that recovery system ejection gases cannot leak out through cracks and holes in the back of the model.

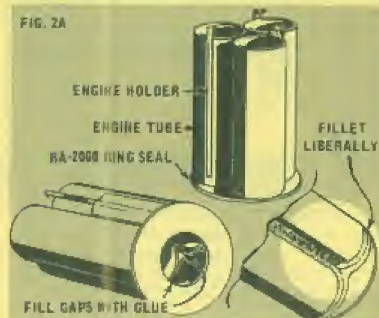
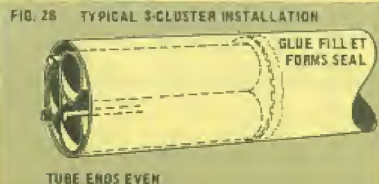


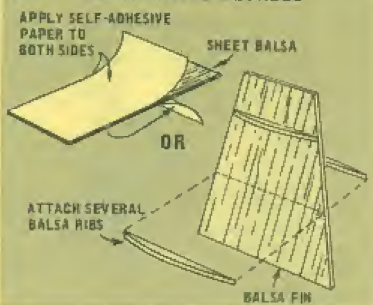
Figure 2 shows a typical engine mounting system for a three-engine model. The spaces between tubes are sealed at the front of the engine mounting tubes by gluing an adapter ring which fits the inside of the body in place as shown. To install the engine mount, smear a liberal amount of glue around the inside of the rear of the body tube. Immediately slide the engine mount unit into place so the rear of the engine mount tubes is even with the rear of the body and the engine retainer hooks project from the tube. Do not pause while inserting the engine mount or the glue may stick with the mount in the wrong place. Set the unit on its rear end while the glue dries.



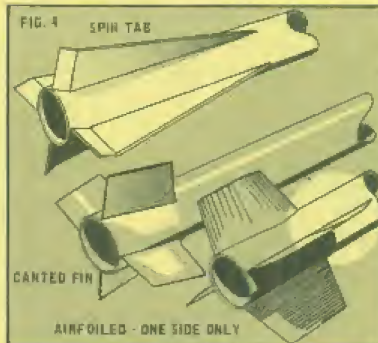
STABILITY

Because the weight of several engines is concentrated in the rear of a cluster rocket, extra attention should be given to designing the rocket so it is stable. Since the engines will not always all be producing exactly the same amount of thrust at the same time, an extra margin of stability is needed. Pay extra attention to the rules in the stability chapter.

FIG. 3 REINFORCING METHODS



The extra load on a cluster model's fins requires that they be made extra strong. One-eighth-inch thick balsa sheet is the most popular fin material for cluster birds. Thinner fin stock can be used, but it should be reinforced for best results.



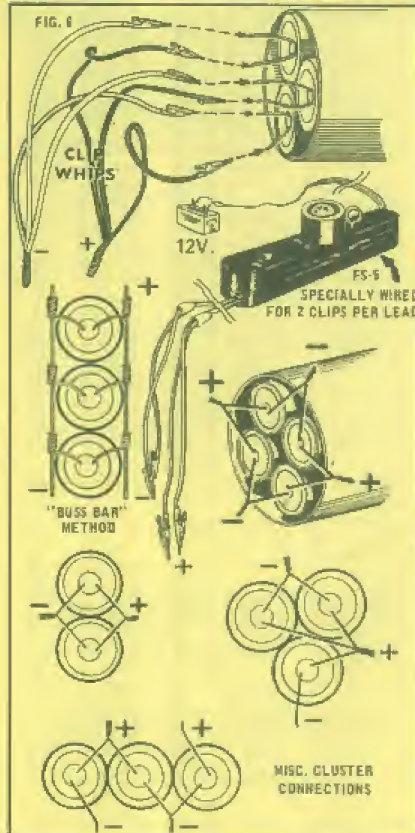
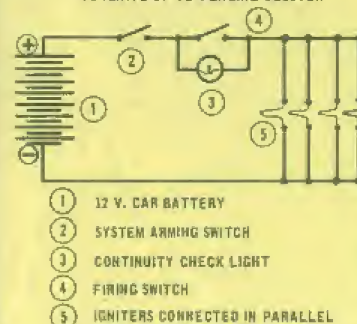
A small amount of spin helps give straighter flights by averaging out uneven thrust. (Too much spin increases drag and reduces performance.) Three methods of providing spin are illustrated. With any system, make sure that all fins or tabs are made to spin the rocket in the same direction.

IGNITION

Ignition is the most important part of successful clustering. All engines must be ignited at the same time. To do this, always use a 12 volt car battery for the power supply and a heavy duty electrical system (such as the Estes FS-5 Launch Control System). Install the igniters carefully and connect them in parallel.

Several typical methods of connecting igniters are shown in figures 5 and 6. Make connections carefully to get good contact and to avoid pulling the igniters from the engines. Always connect igniters in parallel—never in series.

FIG. 5 TYPICAL SYSTEM TO IGNITE UP TO 4-ENGINE CLUSTER



GENERAL INFORMATION

Use a heavy-duty launcher such as the Tilt-a-Pad with cluster models. When heavy rockets are being flown, the launcher should be anchored to the ground with rocks or bricks.

Before installing the engines in your cluster rocket, pack the front of each engine above the ejection end cap with flame-proof wadding. This eliminates the possibility of one engine's ejection charge igniting the ejection charge of another engine and damaging the rocket when one engine in a cluster fails to ignite at lift-off. For more complete information on clustering, see Estes Technical Report #TR-6.

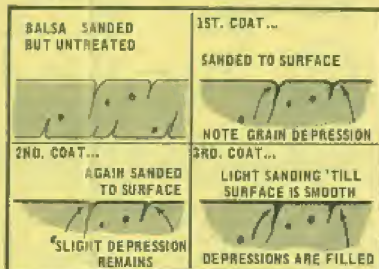
FINISHING



The finish of a rocket starts with the very first steps of assembly. Sloppy gluing and other messy habits will ruin the appearance of a rocket so that nothing can be done to get the perfect appearance which is desired. On the other hand, careful construction will make a model look good even before the paint is applied.

SANDING and SEALING

Paint cannot replace sandpaper. If a balsa surface is not sanded and sealed carefully, it will be impossible to get a smooth paint job. Begin by sanding all balsa surfaces with extra-fine sandpaper until smooth.

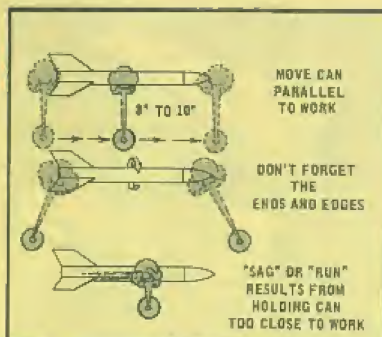


Next, apply a coat of sanding sealer to the balsa. Let this dry completely, then sand with 320 grit (or finer) sandpaper until the surface is smooth again. Apply more sealer, repeating the procedure until all the pores in the balsa are filled.

Practically all of the sealer should be sanded off after each coat. This is because the purpose of the sander is to fill the holes, not the smooth areas of the balsa.

BASE COLOR

Once you feel the balsa surfaces are prepared, it's time to apply the base color. The base color is the lightest of the colors to be used on the model. Usually this will be white. If the model is to be painted with fluorescent colors, the base coat must be white.

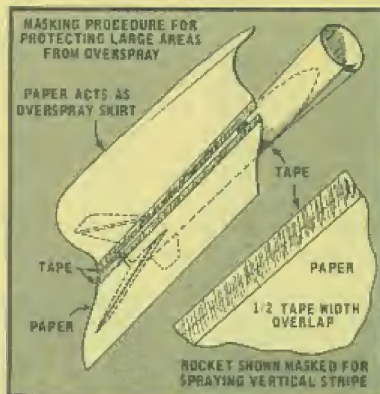
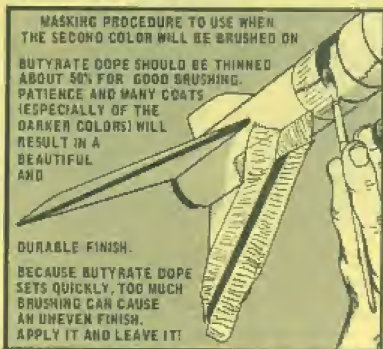


Apply a light, even coat of the base color and set the model aside to dry. Always spray or brush thin coats; thick ones dry slow and tend to "sag". When the first coat has dried completely, sand lightly with extremely fine sandpaper. Wipe any dust off with a clean, slightly damp cloth and apply another coat. Let this dry, then follow with additional light coats until the model has a clear, pure color.

Let the base coat dry completely. Allow at least four hours in a warm, dust-free area (a day is better when possible). Don't let the temperature get over 120° while the model is drying.

THE SECOND COLOR

When the base color has dried, cover all areas on the model which are to remain this color. Cover small areas with masking tape. Large areas should be covered with typing paper, held down at the edges with masking tape. It's important to seal the tape down tightly along the edge.



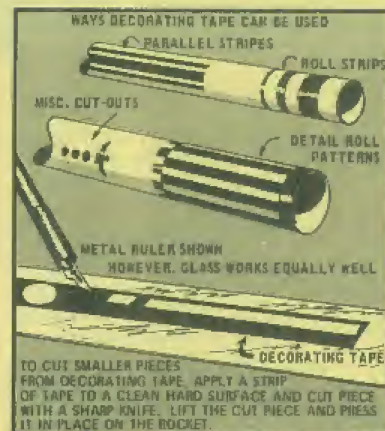
With the model masked, apply an additional thin coat of the first color to finish sealing the edges of the tape. When this is dry, apply the second color in several thin coats. Use just enough paint to get good color. After the last coat is dry, remove the masking carefully to avoid peeling the paint. A third color would be applied in the same way as the second.

FINAL TOUCHES

For best results let the paint dry overnight before applying decals. Most decals should be soaked in lukewarm water for



30 seconds or until they slide on their backing sheets. The decal is then slid so one edge is off the backing. This edge is positioned and held in place on the rocket and the backing pulled out from under. Smooth the decal down with a damp finger and blot away any excess water with a rag.

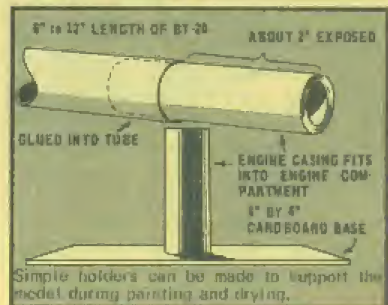


Stripes and bands may be made of either decal material or decorating tape. The pieces should be cut to size before application.

When a model has been finished with fluorescent paint, apply a light coat of clear spray before applying tape or decals. With any paint finish, it is best to apply several coats of clear after the decals have dried to protect them.

Wax may be applied over most enamel or butyrate finishes, but never directly over fluorescent paints. Test the finish to be waxed by applying the wax to an inconspicuous corner of the model or a scrap of tubing with the same paint finish. Some paints will rub off when wax is applied.

NOTE: Enamel paint may be applied over butyrate dope, but NEVER APPLY BUTYRATE DOPE OVER ENAMEL PAINT. If in doubt, test the compatibility of different paints on a piece of scrap material.

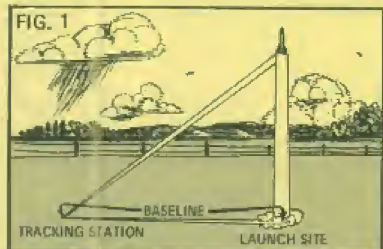


Simple holders can be made to support the model during painting and drying.

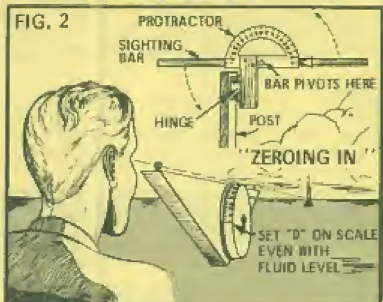
TRACKING

Every rocketeer wants to know how high his models fly. Many methods of determining a model's peak altitude have been tried, but only one method has proven itself. This method is known as triangulation.

The simplest form of triangulation uses only one very simple tracking device. With it, the rocketeer measures the angle between the ground and the line of sight to the rocket at its peak altitude. When this angle and the distance from tracker to launcher are known, it is very easy to determine the altitude.



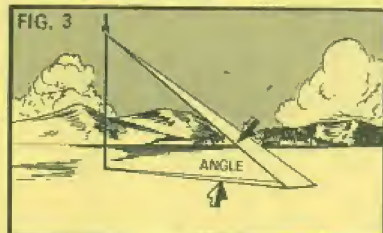
TRACKERS



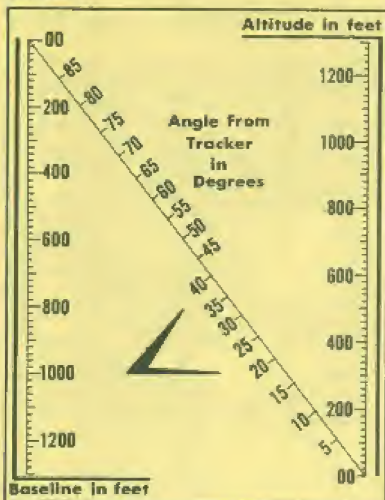
The Estes Altiscope is one of the best all-around basic tracking devices. However, the rocketeer can also easily make his own tracker. An inexpensive plastic protractor, mounted securely on a post set in the ground, with a sighting stick pivoted at the "center" of the protractor, will do the job. The track-

ing device must be set so that it reads 0° when aimed at the rocket on the launcher and 90° when aimed straight up. If the tracker is not "zeroed in" on the launcher, it will give incorrect information.

When the operator at the tracking station is ready, the rocket is launched. He follows the rocket with his tracker as it rises. When it reaches its peak altitude he stops or locks the tracker. The indicated angle is then read from the protractor scale.



The tangent of this angle is found by checking the table on the next page. Multiply the tangent by the distance from tracker to launcher (baseline distance) to find the altitude.

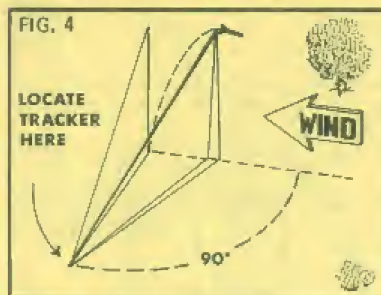


The chart above, called a nomogram, provides a simpler, quicker but less precise

TABLE OF TANGENTS

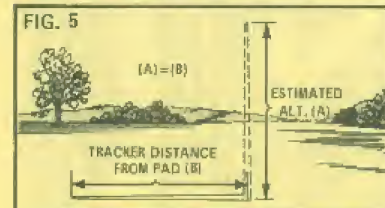
Angle	Tan.	Angle	Tan.	Angle	Tan.
1°	.02	28°	.53	54°	1.38
2	.03	29	.55	55	1.43
3	.05	30	.58	56	1.48
4	.07	31	.60	57	1.54
5	.09	32	.62	58	1.60
6	.11	33	.65	59	1.66
7	.12	34	.67	60	1.73
8	.14	35	.70	61	1.80
9	.16	36	.73	62	1.88
10	.18	37	.75	63	1.96
11	.19	38	.78	64	2.05
12	.21	39	.81	65	2.14
13	.23	40	.84	66	2.25
14	.25	41	.87	67	2.36
15	.27	42	.90	68	2.48
16	.29	43	.93	69	2.61
17	.31	44	.97	70	2.75
18	.32	45	1.00	71	2.90
19	.34	46	1.04	72	3.08
20	.36	47	1.07	73	3.27
21	.38	48	1.11	74	3.49
22	.40	49	1.15	75	3.73
23	.42	50	1.19	76	4.01
24	.45	51	1.23	77	4.33
25	.47	52	1.28	78	4.70
26	.49	53	1.33	79	5.14
27	.51			80	5.67

method for performing the altitude calculation. Draw a straight line from the correct baseline point on the chart, through the measured angle and on across the altitude scale. The correct altitude is the point at which the line crosses the altitude scale.

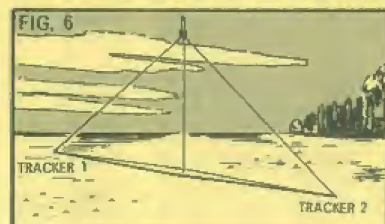


A single tracker will give best results on calm days. Wind interferes with accuracy

since models tend to tilt over into the wind as they fly. The result is that the rocket will not be straight over the launch site at peak altitude, but instead will be some distance over in the direction of the wind. To keep error due to wind drift to a minimum, locate the tracker at a 90° angle to the wind direction as shown.



In determining where to locate a tracking station, estimate the altitude your model will reach. The tracking station should be approximately this distance from the launcher (usually 500 to 1000 feet). Measure the distance from launcher to tracker carefully to insure accurate altitude calculations.



For more precision, use two trackers on opposite sides of the launcher. The easiest way of calculating rocket height using two trackers is to find the altitude for each tracking station and then take the average of these two altitude figures.

More elaborate tracking systems and more elaborate mathematics can be used to gain greater accuracy when the rocket doesn't fly straight up. However, a simple tracking system will do the job very well when good models are flown on calm days. More complete information on basic altitude tracking is contained in Estes Industries Technical Report TR-3.

BOOST-GLIDE

Boost-gliders are models which fly straight up like any other rocket. However, they glide back to earth instead of coming down suspended from a parachute.

There are four main types of boost-gliders: Conventional front engine, conventional rear engine, pop-pod and parasite. Although these types appear very different, many of the same principles apply to all.



A boost-glider, as any other rocket, must be stable to fly upward. For this reason, most boost-gliders are designed with their engine mounts as far forward as possible. During glide a model must still be stable, but not by nearly so great a margin. If most or all of the engine is positioned ahead of the model's balance point, it will help make the model fly correctly.

Rear-Engine Models

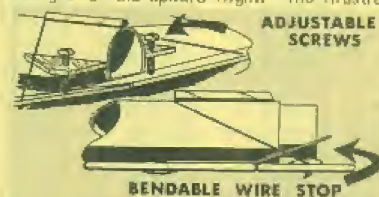
Based on conventional model rockets, the rear-engine boost-glider was the first type developed. Two fins are made extra-large to form wings. Control surfaces, called elevons, are mounted on these wings. The elevons are held straight by the engine during powered flight and coasting. At ejection the engine is expelled from the



of the rocket, and the elevons swing up as shown. This forces the rear of the model down slightly so the wing meets the air at an angle, providing lift to support the model.

Many rear engine models are made with extra empty engine casings mounted to the front of the engine to provide extra weight up forward for better stability. With all rear engine models it is important to remember

that all control surfaces must be perfectly straight for the upward flight. The illustration above shows the control systems of a typical model.



Estes Industries Technical Report TR-4 contains more information on rear engine boost-gliders.

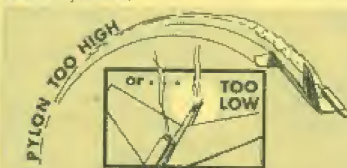
The big problem with rear-engine designs is getting the balance point far enough forward for a good upward flight and still having it far enough rearward for a good glide. The front-engine model solves this by putting the weight of the engine at the extreme front on the way up.

Front-Engine Principles

The engine in a front engine model should be positioned so that its rear is at least as far forward as the middle of the root of the wing. Looking at the model from the side, the centerline of the engine, the bottom surface of the wing,



and the horizontal stabilizer must all be perfectly parallel. If any of these is at an angle, the model will tend to travel in one big loop and will probably be on the ground before ejection.



The pylon that supports the engine holder should be about 1/2 inch high. If it is too high, off-center thrust will force the

nose of the rocket down. If it is too low, the tail will either be scorched or struck by the ejecting engine. For more information on front-engine models, see Estes Technical Report TR-7.

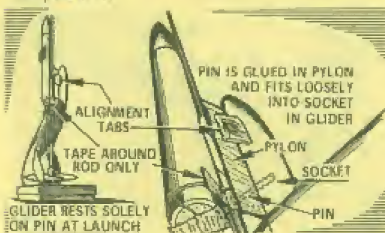
Pop-Pods

For the highest performance from a glider, its weight and drag must be kept to a minimum. The Pop-Pod helps by removing both the weight and drag of the engine



mount. The particular system shown, introduced by Estes Industries, has been adopted by almost every boost-glider designer.

The Estes Pop-Pod (also known as strip pod) can best be explained as a finless parachute or streamer model rocket with a forward-slanting pin on which a glider is hooked. The glider, which fits loosely on the pin, serves to stabilize the whole assembly on the way up. At ejection, the reaction of the nose cone ejecting slows the pod while the inertia of the glider carries it forward and off the hook. (If the pin is a *little* light, the drag of the parachute will usually pull the pod off.)



For this system the pod must be supported on the launch rod with the glider hanging from it. The pod must be loose enough so it will fall off if the glider is held with its nose up. As with conventional front-engine models, the engine, wing and stabilizer must be parallel.

Parasite Gliders

The first parasite glider systems were built with two gliders fitting on opposite sides of a finless, parachute-recovered core. Since then, a wide variety of models has been built on this principle.



For best results, a parasite model should be built with a long, very stable core vehicle. The glider should be mounted close to the center of gravity of the core. One loose pin at the front of the glider is enough to hold it in place on the way up.

Glide Testing

A boost-glider must be "trimmed" to glide correctly before launching. Most rear engine models are trimmed by adjusting the elevons until a straight flat glide is achieved. Other models are trimmed by adding or removing weight at the nose.

When trimming a model, give it a straight, smooth, level toss into the wind and note how it performs. If it stalls, add weight to the nose. If it dives, remove weight from the nose. If it turns too much, place a *very small* weight on the wing which is on the outside as it turns.



Few models are as spectacular in flight and as enjoyable to watch as a good boost-glider. The rocketeer looking for a challenge will find that developing improved boost-glide designs is one of the most rewarding areas of research in model rocketry.

SAFETY

THE DANGEROUS PAST

Most of today's model rocketeers were not concerned with rockets during the "dangerous years" of youth rocketry. These years, from

1957 to 1965, were the years between the time Russia launched the first earth satellite, Sputnik, and the time model rocketry became well known.

In those "early days" when a newspaper article told about a young rocket experimenter, it was usually a tragic story... like the boy in California who loaded a metal pipe with match heads which exploded, killing him instantly and crippling his friend for life... or the teacher who was killed, and seven of his students injured, when he filled an improvised rocket with explosive chemicals. Still another case was of a young man losing an eye using zinc dust and sulphur in a CO₂ cartridge.

These unfortunate incidents happened to thousands of America's young rocketeers. Why? Because the space age had started and practically every science-oriented young man wanted to build a rocket. However, no safe way was readily available for him to do so. The situation was so bad that the Institute of Aeronautics and Astronautics estimated that a "basement bomber" experimenter had a 1 in 7 chance of being seriously injured or killed for each year he participated. A careful

analysis pointed to the following contributing factors as the major reasons for these rocketeer accidents:

1. A strong desire to build and launch a rocket.
2. A plentiful supply of low cost, (readily available) dangerous materials for use in rocket experiments.
3. A lack of knowledge of the dangers involved.
4. The unavailability of safe materials for the experimenter.

The Solution..

The Estes approach to safety for American rocketeers has taken three directions. First—we've tried to make every potential rocket builder aware of the disastrous results of "basement bomber" type activities by telling him of the dangers of home-compounded fuels and metal rockets. Secondly—we've marketed a line of rocket products which can be flown with a high degree of safety. Then, to make it

a complete program, we've provided, along with these carefully engineered products, a wealth of safety oriented literature and technical information. Thus, the rocketeer is guided through his "rocket career" with little chance of serious injury.

Over the past few years, we've received a number of letters from young men saying, "Thank you for saving my life." It's the kind of letter which makes us very proud because it may indeed be the case—and we've met the prime objective of our program.

POSITIVE SAFETY VALUE: These are the words often used to describe the overall safety effect of model rocketry. By using the word POSITIVE we are making reference to a PLUS or ADDITIVE situation. We are, in effect, saying that America's rocketeers will have fewer accidents resulting in personal injury or property loss because model rocketry exists and is widely and freely available.

From YOUTH ROCKET SAFETY REPORT
by Vern Estes -- March, 1967

A Word on Making Rocket Engines...

At the Estes plant rocket engines are made automatically, under controlled conditions, with limited amounts of propellant being measured by explosion proof metering devices. We've spent many thousands of dollars in engine development work and plant layouts. Only highly-trained personnel are permitted near this operation. We still consider it a dangerous job, but a necessary one if we're to provide you with a safe form of rocketry.

If you would like to someday make rocket engines, we'd recommend you first get a college degree. Then you'll need some expensive special equipment, a safe place to work, and some specialized training.

If you attempt to build rocket engines with less than the above, you may find as some chemistry teachers, students and many others have, that through the rest of your life you will be without a finger, hand, arm, eye, ear, face, or you may be badly burned or even killed. Our country needs live rocket scientists and engineers who have all their fingers and hands. We are looking forward to fellows like you who have a special interest in rocketry to fulfill this need.

A "ROCKET" THAT KILLS



The most frequent killer in "basement bomber" tragedies has been a combination of match heads and metallic CO₂ cartridges. Match heads, when confined, are a powerful, sensitive and highly dangerous explosive—wholly unsuitable for rocket experiments.

Deno Bisbee of 5222 E. Darlington Ave. lies in comfort his son, Lynn, 18, as the youth receives emergency treatment at Denver General Hospital after a homemade rocket exploded and blew off part of his right hand Wednesday. "Just tell the other kids to be more careful when they're working with explosives," the science student asked.

—Rocky Mountain News Photo by Harry M. Rhoads.

Dear Sirs
RECEIVED JUNE 11 1966
Recently I was seriously considering building my own rocket with my own home-made fuel system. I thought I received your paper with the report of injuries in such projects. I didn't know about these dangers and now I have decided to leave my model rocketry to the manufacturers and not take on any of these home-made projects. I thought I would write this little note just to thank you for making saving me some injury, no matter how large or small. Thank you very much
ANSWERED JUNE 13 1966
Rich Bolton

ROCKET ENGINE DESIGN

Today's model rocketeer can choose from an amazing variety of engines to power his models. He has an engine available for almost every purpose.

The engines the rocketeer uses come in two main types: end-burning and center-burning. End-burning engines are by far the most popular with model rocketeers. They have a big advantage because they can be built to give a dual level thrust action as shown by the B6-4 thrust curve.

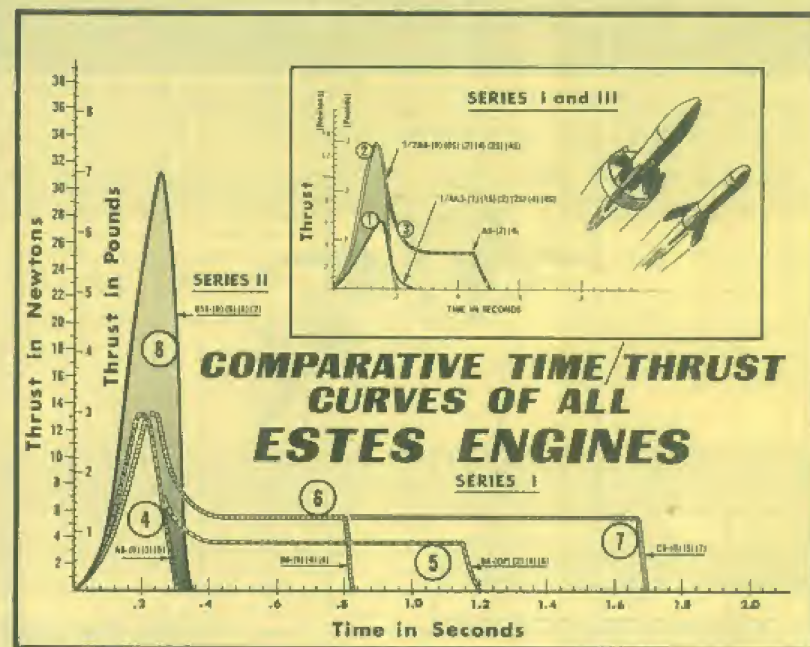
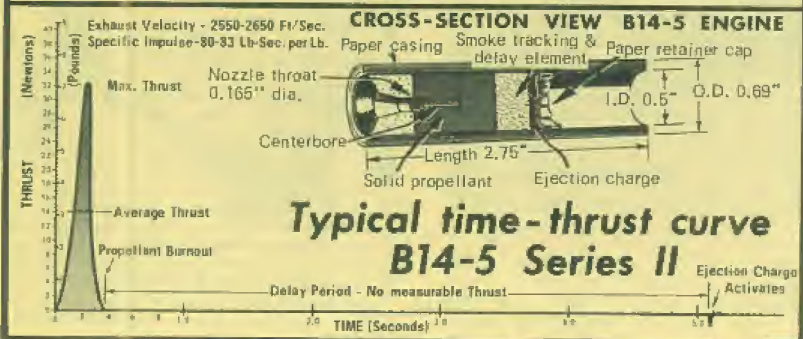
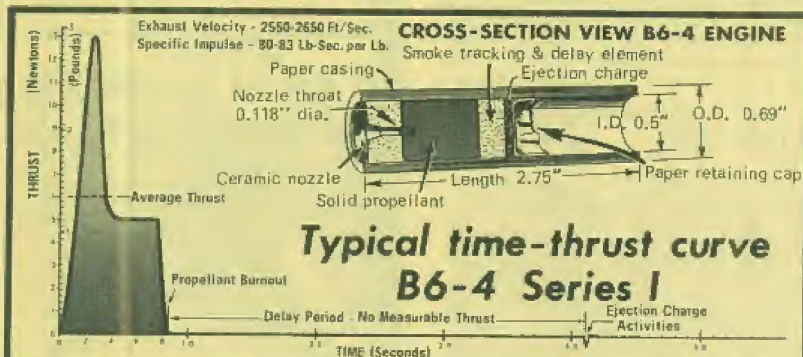
This design is especially effective with light-weight high performance rockets. The high initial thrust boosts the rocket to a suitable flying speed almost immediately; thrust then drops to a lower sustaining level to maintain speed and gain the most distance with the least fuel consumption.

For heavy rockets especially those carrying large payloads, a second type of

engine is available. The center-burning engine produces a very high average thrust, but only for a short period of time. This is more efficient for the heavy rocket since it brings the rocket to an adequate flying speed with less fuel than would be used by low thrust engines. The B14-5 thrust curve is typical of center-burning engines.

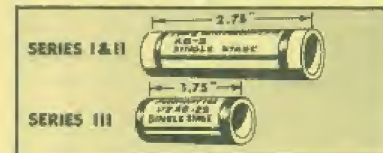
Single and upper stage model rocket engines of both types operate the same after the propellant has been burned. The end of the propellant ignites a slow-burning smoke tracking/delay element. This "delay charge" produces no thrust, but lets the model coast upward, leaving a smoke trail behind.

After several seconds the delay charge ignites an ejection charge which pressurizes the forward end of the rocket body to force the parachute out of the tube. (This gas pressure can be used instead to operate many types of recovery system other than para-



chutes.) If the correct engine is selected, ejection should occur at about the time the rocket has reached its peak altitude.

End-burning engines come in two sizes. The most common, known as Series I, is 2.75 inches long and 0.69 inches in diameter. A smaller type, the Series III engine, is 1.75 inches long, and the same diameter. It is simply a shorter version of certain lower power Series I engines. Center-burning



engines are classified as Series II. For more complete information, see the performance graphs and cut-away drawings.

THRUST CURVES

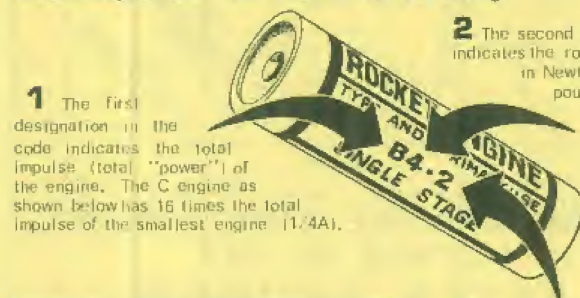
By studying the chart above you can learn much about the expected performance of your model using any type of engine.

For instance, looking at Curve 8 and noting the extremely high thrust of the B14 engine, you'd know your rocket would accelerate quickly to a high velocity. Then, of course, at propellant burn out, it would also slow down quickly due to the high drag of a rocket traveling so fast. The question you'd ask yourself then is...Would my rocket go higher using one of the other B engines which provides less acceleration but keeps pushing for a longer period of time?

NOTE: This rocket engine design and performance information is given for educational purposes only. We believe that if you understand how your rocket engine works you are in a better position to gain scientific knowledge from your activities and to design your rockets for specific purposes such as payload experimentation, altitude studies, drag racing, etc. We DO NOT grant permission for you to attempt to copy our design nor do we recommend that you attempt to build your own rocket engines.

ENGINE CLASSIFICATION

All engines sold by Estes Industries are stamped with a code designation which, when understood, will give the rocketeer important and useful data on the engine's performance capabilities. Here's how to read this coding:



1 The first designation in the code indicates the total impulse (total "power") of the engine. The C engine as shown below has 16 times the total impulse of the smallest engine (1/4A).

2 The second designation, a whole number, indicates the rocket engine's average thrust in Newtons. (1 Newton equals 0.225 pounds). For normal and most high performance flying an average thrust of 3 to 8 Newtons is best. For high lift off weights and high acceleration studies, the Series II engine with an average thrust of 14 Newtons is recommended.

3 The last number following the dash gives the delay time in seconds from thrust burn out to activation of the recovery system (parachute) ejection charge. Engines with an "O" in this position have no delay or ejection charge and are used only in the bottom stage(s) of multi-stage rockets. Series III engines have an "S" following this designation indicating the engine is shorter.

TOTAL IMPULSE CLASSIFICATION		
Code	Pound-Seconds	Newton-Seconds
1/4A	0.14	0.625
1/2A	0.28	1.25
A	0.56	2.50
B	1.12	5.00
C	2.24	10.00

OTHER ENGINE INFORMATION

ENGINEERING:

Today the Estes engine represents the end result of over 11 years efforts in engineering, craftsmanship and quality control. The total impulse of the Estes engine is closely controlled which allows us to make our engines very near the maximum permissible size in a given class. In addition, the average thrust, peak thrust and delay times are set to give the best overall performance for sport flying and competitive events.

QUALITY CONTROL:

Three out of every hundred engines made by Estes Industries are static tested on a recording type of test stand which graphically records the maximum thrust, thrust variations, minimum thrust, overall thrust duration, length of time delay, and the strength of the ejection charge. Any batch of engines which does not meet rigid standards is discarded. In addition, the engine production machines

automatically reject all engines which do not contain the correct amount of propellant. All tolerances are kept as small as possible so that these engines make excellent propulsion units for contests, exhibitions and science studies.

SAFETY:

Rocket engines are not toys, but scientific devices. With common sense and close adherence to safety rules, model rocketry is as safe as any other sport, hobby or scientific study. Carelessness can make it dangerous, as with model airplanes, baseball or swimming. If you are hit by a model rocket traveling 300 or more miles per hour, you will be hurt. Use common sense and follow the safety code. Don't spoil model rocketry's excellent record of safety.

LABEL COLOR:

The label color indicates the recommended use. Green for single stage, purple (or blue) for top stage of multi-stage rockets and red for booster or intermediate stages.

MODEL ROCKET PERFORMANCE

The kits, components and engines produced by Estes Industries have been designed to cover the entire performance range from low altitude sport and demonstration models to high altitude, high performance payload and competition rockets. By choosing his kits, materials and engines carefully, the rocketeer can fill his performance needs exactly. Complete specifications are given on all items to make this selection easy.

HOW HIGH WILL YOUR MODEL GO? The chart below shows the approximate altitudes that can be achieved with single stage rockets.

Engine Size	Altitude Range (depending on rocket size and weight)	Approximate Altitude in a typical 1 oz. model
1/4 A3-2	50' to 250'	100'
1/2 A6-2	100' to 400'	190'
A8-3	200' to 650'	450'
B6-4	300' to 1000'	750'
C6-5	350' to 1500'	1000'

(Some high performance models will reach higher altitudes than shown above.)

ENGINE SIZE:

There are several things that affect the performance of a model. The first of these is engine size. The greater the total impulse of an engine, the higher it will boost a model.

WEIGHT:

In most cases, the heavier a rocket, the less altitude it will reach. A baseball can be tossed higher than an 8 pound cannon ball; the same holds true for model rockets. In addition heavier rockets are more apt to tilt at an angle as they leave the launcher, reducing altitude even more.

Weights listed for rocket kits in the catalog do not include engines. To determine the lift-off weight of a model, add the engine weight, shown in the engine selection chart, to the kit weight.

WIND RESISTANCE:

Drag, or wind resistance, is the third item which affects performance. The more drag on a rocket, the less altitude it will reach. A number of factors determine the amount of drag on a rocket. The more frontal area the rocket has, the greater its drag will be. As a result, large diameter model rockets will generally not reach as great an altitude as smaller diameter rockets with the same engine power. Rough surfaces create turbulence in the air as it flows past the rocket, increasing drag. Smooth finishes will increase the capability of the model. The stability of the rocket also affects drag-if it wobbles in flight, it will have greater drag. Careful attention to reducing drag can sometimes double a rocket's altitude capability.

MEASUREMENTS

METRIC and ENGLISH

Although model rocketry started in the United States, there are today many thousands of active rocketeers in other countries around the world. Because the metric system is standard in almost every nation in which model rocketeers are active, engine specifications based on the metric system have replaced the former English system specifications.

Since rocketeers in this country use both systems of measure, some information will appear using one system, other items will use the other system. The conversion table below makes it easy to change English measurements to metric and vice versa.

CONVERSION TABLE

English to Metric Measure

MULTIPLY-----BY-----TO OBTAIN	MULTIPLY-----BY-----TO OBTAIN
centimeters 0.3937 inches	meters 39.37 inches
feet 0.3048 meters	meters 3.281 feet
feet 0.3048 meters per second	meters 3.281 feet per second
grams 0.0353 ounces	newtons 0.225 pounds (force)
kilograms 35.3 ounces	newton-seconds 0.225 pound-seconds
kilograms 2.207 pounds	ounces 28.35 grams
inches 25.4 millimeters	pounds (force) 4.45 newtons
millimeters 0.0394 inches	pound-seconds 4.45 newton-seconds



4.45 Newtons = 1 Pound of Force

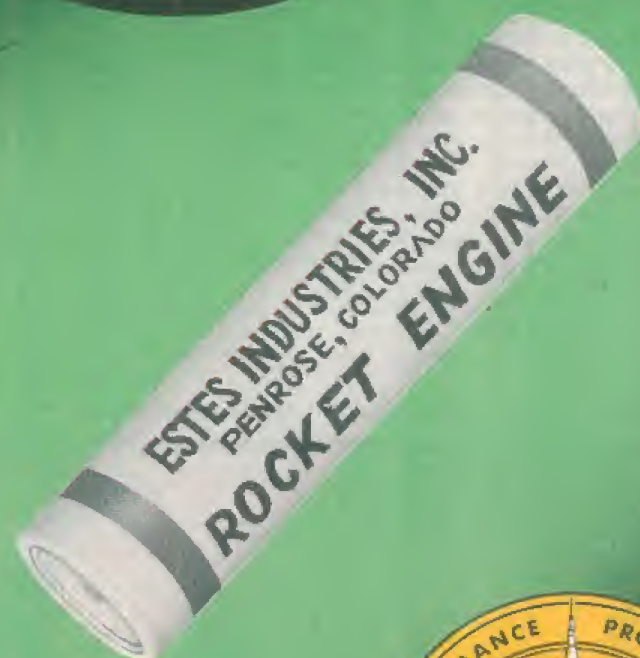
Energy is required to make an object move. This energy which causes motion is applied as a **FORCE**. Scientists express forces in units of measurement call **NEWTONS**. A newton is the amount of force needed to move a mass of one kilogram with an acceleration (change in velocity) of one meter per second each second. In other words, a force of one newton will make a mass of one kilogram change speed by one meter per second during every second the force is acting.

ACCELERATION (in meters per second per second) = FORCE IN NEWTONS ÷ MASS IN KILOGRAMS

EXAMPLE:

A Saturn model rocket of 0.36 kilograms (12.54 oz.) mass, acted upon by a force of 24 newtons (5.400 lb.), will be accelerated at the rate of 66.6 meters (218 ft.) per second per second.

ESTES



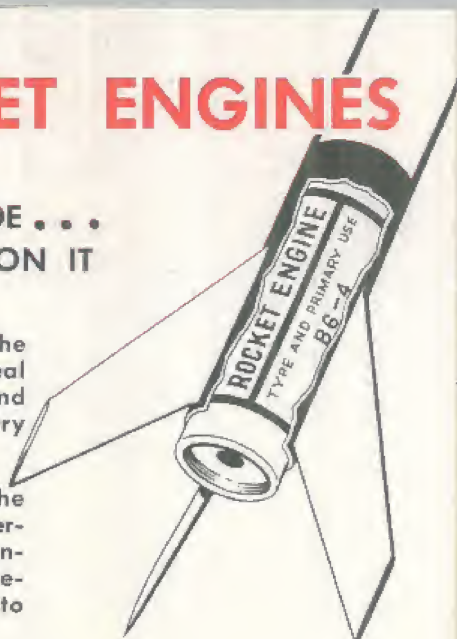


ESTES ROCKET ENGINES

THE FINEST ENGINE MADE . . .
. . . YOU CAN DEPEND ON IT

The design and development of the Estes model rocket engine was the real beginning of the safe, educational and exciting program that model rocketry has become.

Today's modern rocket engine is the result of over 10 years of engineering efforts at Estes Industries. Consequently, today's rocketeer has dependable, safety-proven engines to carry on his rocket activities.



Designed for specific launch and flight functions, rocket engines are expendable — not re-usable.

Graphic explanation of a rocket engine's fundamental construction and functions.



CUT-AWAY
ENGINE



Ejection charge
for deployment of
recovery system



Non-thrust delay and
smoke tracking charge



High thrust charge for
lift-off and acceleration



Technical information on rocket engines will be found on pages 76-78.

. . . for every flight application

PERFORMANCE TESTED ENGINES FOR HIGH PERFORMANCE FLIGHTS

The energy-packed, solid propellant Estes model rocket engine is a complete power system for your rocket. It is designed and pre-manufactured to perform all power functions for dependable launch and activation of a recovery system. In one compact package it provides thrust for quick lift-off and acceleration to high altitudes, allows for a timed delay period to reach peak altitude while delivering smoke trail for easy tracking, and supplies ejection power for the parachute or other system for your rocket's safe return to earth.

Reliability-proven in over 14 million launchings, Estes engines are manufactured under controlled conditions within exacting tolerance limits. You can count on them for consistent performance from one launch to the next. You'll launch with confidence in contest and exhibition flying.

Five power levels are available in Estes engines. Total impulse is tailored to fit the various NAR-FAI classes. Average thrust, peak thrust and delay times are set to give the best performance within these classes and to provide the most useful selection of engines for all rocketeers.

Engine prices and basic data are listed on pages 84-85.

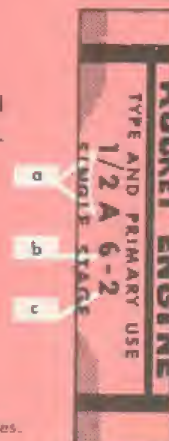
ENGINE CODING FOR QUICK-N-EASY IDENTIFICATION

1. Label color indicates recommended use of the engine.

- a. GREEN Single stage rockets
- b. PURPLE & BLUE Top stage of multi-stage rockets
- c. RED Booster and intermediate stages of multi-stage models

2. Code designation stamped on the engine gives useful and important information on its performance capabilities.

- a. This portion indicates total impulse or total power produced by the engine.
- b. This portion shows the engine's average thrust in newtons and helps you choose the right engine for your rocket's flight
- c. This number gives you the delay in seconds between burnout and ejection charge. Lets you choose the engine with the delay time you want for any flight.



Igniters and complete instructions are included with Estes engines.



ROCKET ENGINE

Prices and Specifications

SELECTION CHART

Data for correct engine choice

Cat. No. and Engine Type	Prices		Total Impulse		Time Delay (±15%)	Maximum Lift-off Weights With Engines	Maximum Thrust	Thrust Duration	Initial Weight		Propellant Weight		Replaces Old Engine Type
	Each	3 for	lb sec. ¹⁾	n-sec.					Oz.	Gr.	Oz.	Gr.	
SINGLE STAGE ENGINES							GREEN LABEL						
1/4A3-1	\$.25	\$.65	0.14	0.625	1 sec	1.5 oz.	22 oz.	0.24 sec	0.48	13.6	0.027	0.78	1/4A.8-2
1/4A3-1S**	\$.25	\$.65	0.14	0.625	1 sec	1.5 oz.	22 oz.	0.24 sec	0.36	10.2	0.027	0.78	1/4A.8-2S
1/4A3-2	\$.25	\$.65	0.14	0.625	2 sec	1.0 oz.	22 oz.	0.24 sec	0.50	14.2	0.027	0.78
1/4A3-2S**	\$.25	\$.65	0.14	0.625	2 sec	1.0 oz.	22 oz.	0.24 sec	0.38	10.8	0.027	0.78
1/2A6-2	\$.30	\$.70	0.28	1.25	2 sec	2.5 oz.	46 oz.	0.20 sec	0.53	15.0	0.055	1.56	1/2A.8-2
1/2A6-2S**	\$.30	\$.70	0.28	1.25	2 sec	2.5 oz.	46 oz.	0.20 sec	0.41	11.6	0.055	1.56	1/2A.8-2S
A5-2	\$.35	\$.80	0.56	2.50	2 sec	3.0 oz.	46 oz.	0.50 sec	0.59	16.7	0.110	3.12
A8-3	\$.35	\$.80	0.56	2.50	3 sec	4.0 oz.	48 oz.	0.32 sec	0.57	16.2	0.110	3.12	A.8-3
B4-2	\$.40	\$.90	1.12	5.00	2 sec	4.0 oz.	48 oz.	1.20 sec	0.70	19.8	0.294	8.33	B.8-2
B4-4	\$.40	\$.90	1.12	5.00	4 sec	3.5 oz.	48 oz.	1.20 sec	0.74	21.0	0.294	8.33	B.8-4
B6-4	\$.40	\$.90	1.12	5.00	4 sec	4.5 oz.	48 oz.	0.83 sec	0.78	22.1	0.220	6.24	B.8-4
B14-5*	\$.50	\$ 1.00	1.12	5.00	5 sec	5.0 oz.	7 lb.	0.35 sec	0.69	19.6	0.220	6.24	B3-5
C6-3	\$.45	\$.95	2.25	10.00	3 sec	4.0 oz.	48 oz.	1.70 sec	0.88	24.9	0.440	12.48
C6-5	\$.45	\$.95	2.25	10.00	5 sec	4.0 oz.	48 oz.	1.70 sec	0.91	25.8	0.440	12.48
UPPER STAGE ENGINES ④							PURPLE or BLUE LABEL						
1/4A3-4	\$.25	\$.65	0.14	0.625	4 sec	.75 oz.	22 oz.	0.24 sec	0.51	14.5	0.027	0.78	1/4A.8-4
1/4A3-4S**	\$.25	\$.65	0.14	0.625	4 sec	.75 oz.	22 oz.	0.24 sec	0.39	11.1	0.027	0.78	1/4A.8-4S
1/2A6-4	\$.30	\$.70	0.28	1.25	4 sec	1.0 oz.	46 oz.	0.20 sec	0.54	15.3	0.055	1.56	1/2A.8-4
1/2A6-4S**	\$.30	\$.70	0.28	1.25	4 sec	1.0 oz.	46 oz.	0.20 sec	0.42	11.9	0.055	1.56	1/2A.8-4S
A5-4	\$.35	\$.80	0.56	2.50	4 sec	1.5 oz.	46 oz.	0.50 sec	0.64	18.1	0.110	3.12	A.8-4
A8-5	\$.35	\$.80	0.56	2.50	5 sec	2.0 oz.	48 oz.	0.32 sec	0.62	17.6	0.110	3.12
B4-6	\$.40	\$.90	1.12	5.00	6 sec	1.5 oz.	48 oz.	1.20 sec	0.78	22.1	0.294	8.33	B.8-6
B6-6	\$.40	\$.90	1.12	5.00	6 sec	2.0 oz.	48 oz.	0.83 sec	0.71	20.1	0.220	6.24	B.8-6
B14-6*	\$.50	\$ 1.00	1.12	5.00	6 sec	3.5 oz.	7 lb.	0.35 sec	0.71	20.1	0.220	6.24	B3-6
B14-7*	\$.50	\$ 1.00	1.12	5.00	7 sec	2.5 oz.	7 lb.	0.35 sec	0.73	20.7	0.220	6.24	B3-7
C6-7	\$.45	\$.95	2.25	10.00	7 sec	2.5 oz.	48 oz.	1.70 sec	0.95	26.9	0.440	12.48
BOOSTER ENGINES							RED LABEL						
1/2A6-0	\$.30	\$.70	0.28	1.25	none	4.0 oz.	46 oz.	0.18 sec	0.48	13.6	0.055	1.56	1/2A.8-0 ^⑦
1/2A6-0S**	\$.30	\$.70	0.28	1.25	none	4.0 oz.	46 oz.	0.18 sec	0.36	10.2	0.055	1.56	1/2A.8-0S ^⑦
A8-0	\$.35	\$.80	0.56	2.50	none	4.0 oz.	48 oz.	0.30 sec	0.51	14.2	0.110	3.12	A.8-0
B6-0	\$.40	\$.90	1.12	5.00	none	4.0 oz.	48 oz.	0.80 sec	0.58	16.4	0.220	6.24	B.8-0
B14-0*	\$.50	\$ 1.00	1.12	5.00	none	6.0 oz.	7 lb.	0.35 sec	0.61	17.3	0.220	6.24	B3-0
C6-0	\$.45	\$.95	2.25	10.00	none	4.0 oz.	48 oz.	1.68 sec	0.80	22.7	0.440	12.48	C.8-0
STATIC TEST ENGINE ⑧							BLACK LABEL						
B4-0(P)	\$.45	\$.95	1.12	5.00	none	Don't Fly It!	48 oz.	1.20 sec	0.69	19.6	0.294	8.33	B.8-0(P)

Complete instructions and igniter (#NW1-1) are included with each rocket engine ordered from Estes Industries.

*Series II engine, 2.75 in. lg.

**Series III engine, 1.75 in. lg.

① Pound-seconds

② Newton-seconds (figures shown are maximum)

③ Closest previous equivalent is shown

④ OR single stage engines if used in very light rockets.

⑤ Replaces both 1/4A.8 and 1/2A.8 booster engines

⑥ Static test engine with plug to prevent blow-through

Comparative time thrust curves on all Estes engines are shown on pages 76 & 77

Shipping wt. of each engine is approximately 1 1/2 oz.

The Key to **SAFE** dependable launches

Estes Launching systems and components are designed for perfect lift-off of your rockets. Advanced features include space age miniaturization, self powered, launch-anywhere units with push button control, key controlled safety interlock and continuity check light.



COMPLETE LAUNCHER ASSEMBLY

- electric ignition
- hand held control unit
- safety interlock
- continuity check light
- adjustable launch angle
- collapsible 2-piece launch rod
- easy to assemble kit with instructions

ELECTRO — LAUNCH

The biggest little launcher in the world

THE completely self-contained launching system for "all in one" ease and mobility. A high impact plastic base and extra large blast deflector assures dependable operation throughout your rocketry career. Features push button ignition control from a hand held unit with a safety interlock and check light to prevent misfiring. Requires 4 size D photo-flash cells (not included) for 6 volt operation. Easily converts to 12 volts for extended battery life and heavy duty use by adding 4 extra batteries and changing to a 12 volt pilot bulb. Use it for rockets weighing up to 6 oz., or anchor the base to the ground for heavier models. For launching cluster models, add extra battery pack (page 90) or use LAUNCH CONTROL SYSTEM FS-5 (page 87) with 12 volt car battery. Shipping wt. 30 oz.

Cat. No. 691-FS-4 \$4.00

Self contained for full mobility

Same kit as above, but batteries for 6 volt operation included. Shipping wt. 46 oz. Cat. No. 691-FS-4B . . \$5.00

See page 91 for replacement batteries.



Electric launching with **ESTES** systems



LAUNCH CONTROLLER SWITCH

Designed for a perfect countdown and launch sequence. Same as in the ELECTRO-LAUNCH, it features safety interlock, continuity check light and push button controlled launching. Comes in kit with 6 or 12 volt (specify when ordering) pilot light and instructions for wiring into your system or portable launcher. Shipping wt. 6 oz. Cat. No. 671-FSS-4 \$1.50



Complete LAUNCH CONTROL SYSTEM

The perfect system to modernize and add flexibility to your launching program. Use with a 12 volt car battery for any model, including the large birds. Kit includes the above launch controller panel, 18 ft. of No. 18-2 zip cord, micro clips, battery clips, and assembly instructions. Available for use with either 6 or 12 volt power supplies. Specify voltage when ordering. Shipping wt. 12 oz.

Cat. No. 651-FS-5 \$3.00

These systems usable with auto battery or other heavy duty power supply.

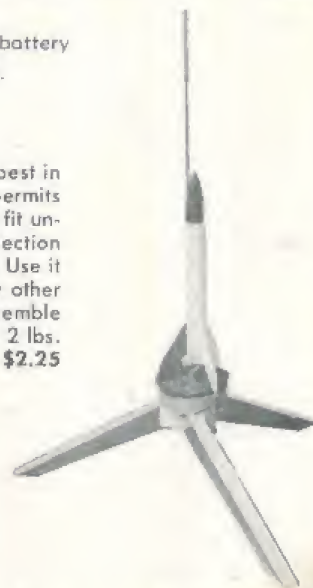
TILT-A-PAD LAUNCHER

Unbeatable for flexibility. Gives you the very best in launch control and convenience. Tripod stand permits launching of rockets up to 12 oz. (and adjusts to fit uneven ground). Tilts to compensate for wind direction and speed. Legs fold down for compact storage. Use it with Launch Control System FS-5 (above) or any other electrical ignition system. Comes in easy to assemble kit form with complete instructions. Shipping wt. 2 lbs. Cat. No. 691-RL-3 \$2.25

EXTRA INTERLOCK KEY.

for Electro-Launch and above systems.

Cat. No. 651-FSK-4 \$.10 ea.



RAIL LAUNCHING

... with aluminum "C" rails

They're stronger, more rigid than rods — and offer countless new possibilities for your launcher designs

The rail is a hollow square shape with its cross section in the form of a squared C. This new concept in lift off guidance permits greater flexibility in launcher design and construction. With the rail your rocket is guided at lift-off by lugs travelling smoothly inside the length of the hollow opening, making possible many structural adaptations not useable with a rod type launcher.

The rail can be attached to rigid structures for launcher designs or devices for precise angle adjustment. It offers great possibilities for scale or semi-scale models of America's space launch facilities.

A few design possibilities are illustrated. Many other exciting rail launch designs of the future will come from your own experiments.

Any model rocket can be adapted to rail launching and several proven lug designs are shown in the box below

Nylon screws (AS-1) turned into body tube, trimmed and glued in place.

Two pieces of thin hardwood cut from tongue depressor or stir stick, glued into "T" rail form, then glued to rocket.

Length of WD-2 topped by a length of LL-2.



"C" RAIL: $\frac{3}{8}$ " square (outside). Comes in 18" long sections. Durable aluminum for long life and rust free service. Use at least 2 sections connected with a joiner (see below) for launch rail. Shipping weight 6 oz.

Cat. No. 681-LR-18A

\$.50 each section

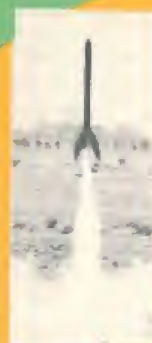
RAIL JOINER: Spring clip 2" long by $\frac{1}{4}$ " wide fits inside rail ends, holds two rail sections securely together for assembling launch rails 36" long and longer. Shipping weight 2 oz.

Cat. No. 691-RJ-18A

\$.30 each



Don't Stop Now



Straight up



Wow! What a lift-off



Launch into the wind

OR

Where the ACTION begins



A-OK

Launching's Half the Fun of Rocketry



You can count on Estes models for dependable launches time after time . . .



All Systems "GO"



Will she go?



You bet!



ESTES

LAUNCHING SPACE AND MORE

LAUNCHING SUPPLIES



BATTERY PACK: Durable plastic cased 12 volt battery pack, ideal for use as a booster for the Electro-Launch, a power supply for other launchers, phone systems or any other range power application. Can be set up to deliver 3, 6, 9, or 12 volts, requires 2, 4, 6, or 8 size D cells (not included) depending on voltage desired. Comes in kit form with complete instructions. Shipping weight 1 pound.

Cat. No. 691-BP-2 \$2.00 each



TWO PIECE ROD: Handy collapsible two piece rod for portable launchers. Pieces slip together to make a 36" long rod. Base rod has a diameter of 1/8". Shipping weight 6 oz.

Cat. No. 651-RLR-1 \$.35 each



ADD ON ROD: Sturdy 1/8" diameter, 18" long launch rod section expands two piece rod (see above) to 53" length, gives extra control of flight path — especially with heavier models. To assemble, separate two piece rod, insert tapered end of add-on rod into hole in lower rod, insert upper rod into hole in add-on section. For a constant 1/8" diameter launch rod, join two or three add-on sections together. Shipping weight 6 oz.

Cat. No. 651-RLR-3 \$.20 per section



DELUXE BLAST DEFLECTOR: Durable pressed steel plate deflects engine blast out and away from launcher. Two inches wide, five inches long. Ideal for launchers that receive extensive use. Shipping weight 5 oz.

Cat. No. 651-BD-1 \$.60 each



BLAST DEFLECTOR PLATE: Slip-on metal deflector plate fits any launcher using 1/8" rod, protects launcher base from rocket blast. Four inch diameter. Shipping weight 5 oz.

Cat. No. 651-BD-2 \$.35 each



PIVOT: Adjustable launch rod mounting pivots up to 25° to compensate for tilt of launcher base, windage, etc. Easy-to-assemble, mounts to launcher base with 2 #4 screws. (Rod not included.) Shipping weight 2 oz.

Cat. No. 651-LP-1 \$.35 each



IGNITERS: Easy-to-use, extra reliable igniters — the same type as supplied with all Estes engines. Suitable for ignition systems using 6 volts or more, see engine instructions for installation procedure. (Patent No. 3,363,559) Shipping weight 1 oz.

Cat. No. 651-NWI-1 6 for \$.15

NICHROME WIRE: Electrical heating wire for model rocket ignition. #30 recommended for use with car batteries, #32 for use with other power supplies. Shipping weight 1 oz.

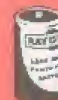
#30, 15 FOOT ROLL: Cat. No. 651-NW-30A \$.50 each

#32, 15 FOOT ROLL: Cat. No. 651-NW-32A \$.50 each



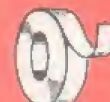
BATTERIES: Extra powerful size D photoflash batteries pack the energy needed for rocket launching. These are the type specified for the Electro-Launch, deliver up to 16 amperes of current on a complete short when fresh. Shipping weight 4 oz. each.

Cat. No. 651-PFB-1 \$.30 each



MASKING TAPE: Use to secure engines in models, mask for painting, etc. Strong, flexible 1/2" wide tape comes in 30' rolls. Shipping weight 5 oz.

Cat. No. 651-MT-1 \$.30 each



MICRO-CLIPS: Equip your launcher with the best. Spring-loaded solid copper clips attach lead wires to igniters. Easy to clean and highly conductive with flat contact surfaces. Only 1.1 inches long, attach to leads with or without solder. Shipping weight 1 oz.

Cat. No. 651-MC-1 2 for \$.25



GIANT BATTERY CLIPS: Ideal for hookup to car batteries, heavy duty clips connect to terminals up to 1" in dia. Clips are 3" long, available with black or red insulators. Specify color(s) when ordering. Shipping wt. 5 oz.

Cat. No. 651-BC-1 \$.40 each



BATTERY CONTACTS: Spring brass battery clips for special battery installations, replacement part for the Electro-Launch. Fit size D cells, can be trimmed to fit smaller batteries. Shipping weight 1 oz.

Cat. No. 651-BC-2 2 for \$.20



LEAD WIRE: Flexible, durable size 18 two conductor insulated wire. Ideal as a lead from firing panel to launcher, zip the conductors apart for wiring inside the panel. In 12 foot lengths. Shipping weight 5 oz.

Cat. No. 651-LW-12 \$.70 each



TERMINAL LUGS: Tiny 1/2" long solderless lugs make electrical connections a snap — insert bare wire into the end of the lug and crimp in place with pliers. 1/8" hole for terminal. Shipping weight 1 oz.

Cat. No. 651-TL-1 \$.05 each



Electrical EQUIPMENT



PILOT LIGHT HOLDER: Add visual control to your launch panel by wiring in an arm or continuity check pilot light. Holder is steel with 1/2" red plastic jewel, mounts in 7/16" hole. Takes either 6 or 12 volt bulbs, bulb not included. Shipping weight 4 oz.

Cat. No. 651-LH-1 \$.45 each



6 VOLT BULB: Fits holder No. LH-1. Shipping weight 1 oz. (Type 51.)

Cat. No. 651-AL-6 \$.20 each

12 VOLT BULB: Fits holder No. LH-1. Shipping weight 1 oz. (Type 53.)

Cat. No. 651-AL-12 \$.20 each



KEY SAFETY SWITCH: A must for every control panel. Prevents accidental launching of rockets. SPST, turns on with key, must be turned off to remove key. Mounts in 1/2" hole. One key included with switch. Shipping weight 4 oz.

Cat. No. 691-KSW-1A \$2.75 each

EXTRA KEY: Cat. No. 651-KSW-1K \$.25 each



PUSH BUTTON SWITCH: Heavy duty construction momentary type, SPST, normally open. Excellent for use as a firing switch. Mounts in 1/2" hole. Shipping weight 4 oz.

Cat. No. 651-SWM-1 \$.90 each



ROTARY SWITCH: Twelve position single pole rotary switch — just right for use as a selector switch with firing systems using more than one launcher. With twelve positions, this switch should handle almost any need. Non-shorting, mounts in 3/8" hole. Shipping weight 5 oz.

Cat. No. 651-SWR-1 \$1.35 each



DIAL PLATE: Numbered 12 position plate for use with rotary switch No. SWR-1. Mounts on panel with same nut used to hold switch. Etched aluminum on black background. Shipping weight 1 oz.

Cat. No. 651-DP-1 \$.25 each



SOLDERING IRON: 25 watt, top quality tool for making good connections in launchers and other electrical circuits. Does the work of irons of higher wattage. Develops up to 720° F. Handle remains cool. Replaceable, pre-tinned nickel-plated tip gives extra long life. Use with ROSIN core solder. Shipping wt., one pound.

Cat. No. 671-SI-1 \$4.00

DRAFTING AND DESIGNING EQUIPMENT



TRIANGLE SET

Clear plastic triangles are perfect for drafting and designing work. Set includes one 6" 45° triangle and one 8" 30°-60° triangle. Beveled edges — accurate — precise. . . recessed lifts from both sides permit clean, easy pick-up. Shipping weight 6 oz.

Cat. No. 651-DT-2 \$.65 per set p.p.



FRENCH CURVE

Precision-made with sleek-finished edges of hairline accuracy. Perfect for designing nose cones, plotting curves, etc. Shipping weight 4 oz.

Cat. No. 651-DC-1 \$.25 each p.p.



PROTRACTOR

Large 6" clear plastic protractor makes angle measurements a "snap." Features sharp graduations, accurate 6" ruler at the base. Shipping weight 4 oz.

Cat. No. 651-DP-6 \$.15 each p.p.



RULE

All purpose steel rule is graduated in inches on one edge and millimeters on the other to give fast, accurate measurements. Ideal both for design and construction work, this flexible stainless steel rule has a new non-slip backing for precise positioning. Shipping wt. 11 oz.

Cat. No. 691-DR-3 \$1.00 each



12" T-SQUARE

Precision-made, clear plastic 12 inch T-square is accurate and easy to use. Smooth straight edges are marked in inches and millimeters. Shipping weight 11 oz.

Cat. No. 651-DR-2 \$.30 each p.p.



METAL COMPASS

Sheet metal German tool does double duty — can be used as pencil compass or divider. Includes metal capsule of leads. Shipping weight 4 oz.

Cat. No. 651-DC-2 \$.35 each p.p.



BOW COMPASS

Giant bow compass features thumb screw adjustment, interchangeable points for use as divider, ink or pencil compass. Heavy gauge nickel plated steel. Shipping weight 6 oz.

Cat. No. 651-DC-3 \$1.10 each p.p.

RECOVERY EQUIPMENT & SUPPLIES



PARACHUTE KITS: Get the best in parachute recovery! Two color printed plastic 'chutes give maximum visibility — feature easy to see pattern. Lightweight, durable and easily folded, these 'chutes are only 0.00075" thick, allowing the most material to be packed into the least body space. Each kit comes complete with 'chute material, tape strips and shroud lines.

Specify color combination and size when ordering. Shipping weight 2 oz.

Cat. No.	Parachute Diameter	Color Combinations Available	Net Weight	Price Each
691-PK-8	8 inches	Orange and White Red and White Red and Yellow	.035 oz.	\$.20
651-PK-12	12 inches	Yellow and Black Orange and Black	.078 oz.	\$.20
651-PK-18	18 inches	Red and White Red and Yellow Orange and Black	.144 oz.	\$.30
651-PK-24	24 inches	Red and White Orange and Black	.298 oz.	\$.40

PARACHUTE MATERIAL: You get a big square yard of extra strength, high visibility black plastic 'chute material. Each sheet can be cut to make one or more round or square parachutes up to 36" across. Net weight .98 oz. Shipping weight 5 oz.

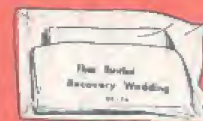
Cat. No. 651-PM-2 \$.45 each

STREAMER MATERIAL: Bring light weight models back to earth with bright orange, flame resistant crepe paper streamers. In 7 1/2 foot lengths, enough for two to eight streamers. Available in 1" and 2" widths. Specify size when ordering. Shipping weight 1 oz.

1" wide Net wt. .092 oz.
Cat. No. 651-SM-1 3 for \$.30

2" wide Net wt. .184 oz.
Cat. No. 651-SM-2 3 for \$.40

RECOVERY WADDING: Extra soft and flexible, light weight tissue paper (bathroom type), specially treated to make it flame resistant. Gives the very best protection from hot ejection gases for parachutes and streamers. Each package contains approximately 75 4 1/2" squares — enough wadding for up to 25 flights. Instructions included in package. Shipping weight 6 oz. Cat. No. 651-RP-1A \$.25 each



SHROUD LINES: Build reliable, durable custom parachutes with this strong, hard surface shroud line cord. Comes in 72 yard spools. Shipping weight 5 oz.
Cat. No. 651-SLT-1 \$.25 each



SCREW EYES: Attach recovery systems to nose cones or nose blocks with these light weight metal screw eyes. Available in three sizes, specify size when ordering. Shipping weight for 3 eyes 1 oz.

LARGE EYE: 1" long; .04 oz.; Cat. No. 651-SE-1 3 for \$.10

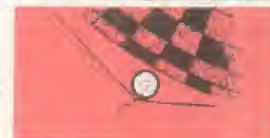
SMALL EYE: 3/4" long; .03 oz.; Cat. No. 651-SE-2 3 for \$.10

EXTRA SMALL

EYE: 5/8" long; .01 oz.; Cat. No. 651-SE-3 3 for \$.10

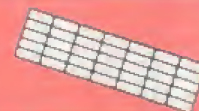


TAPE DISCS: Fasten shroud lines to plastic 'chutes or streamers with these 3/4" pressure sensitive tape discs. Shipping weight for 12 discs, 1 oz. Cat. No. 651-TD-1 12 for \$.15



TAPE STRIPS: For top strength, low bulk and low weight, fasten shroud lines with these 1/4" x 3/4" tape strips. In sheets of 35 strips, shipping weight 1 oz.

Cat. No. 651-TD-2 \$.30 per sheet



SHOCK CORD: Convenient 18" lengths of model airplane contest rubber to absorb shock of ejection and recovery system deployment. In 3/8" widths for normal models, 1/4" widths for heavy rockets. Specify width when ordering. Both are .03" thick. Shipping weight 1 oz.

1/8" wide: Net wt. 0.039 oz., Cat. No. 671-SC-1 \$.10 each

1/4" wide: Net wt. 0.078 oz., Cat. No. 671-SC-2 \$.15 each

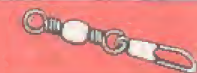
Also 36" long for greater stretch on those larger birds.

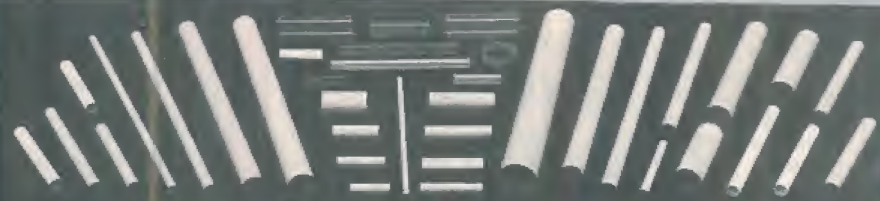
1/8" wide: Net wt. 0.078 oz., Cat. No. 681-SC-3 \$.20 each



SNAP SWIVELS: For quick changes and reduced tangling in your recovery systems, use these tiny 1" long snap swivels. Net weight .01 oz. Shipping weight for 6 swivels 1 oz.

Cat. No. 651-SV-12 6 for \$.20





FOR BUILDING ROCKETS OF YOUR OWN DESIGN

ROCKET BODY TUBES

Cat. No.	Price Each	Length	Inside Diameter	Outside Diameter	Wall Thickness	Wt. in Ounces Net	Ship.
BT-5, Spiral-Wound Paper Tube, for nose sections and strap-on payloads							
651-BT-5	\$.30	18"	0.515"	0.541"	0.013"	.219	11
651-BT-5P	\$.15	5.1"	0.515"	0.541"	0.013"	.062	4
BT-10, Mylar Plastic Tube, for featherweight models							
651-BT-10	\$.25	9"	0.710"	0.720"	0.005"	.088	4
651-BT-10H	\$.10	3.062"	0.710"	0.720"	0.005"	.029	1
BT-20, Spiral-Wound Paper Tube, for competition and sport models							
651-BT-20	\$.30	18"	0.710"	0.736"	0.013"	.288	11
651-BT-20B	\$.15	8.65"	0.710"	0.736"	0.013"	.138	4
651-BT-20D	\$.15	6.5"	0.710"	0.736"	0.013"	.104	4
651-BT-20G	\$.10	3.5"	0.710"	0.736"	0.013"	.056	4
651-BT-20J	\$.10	2.75"	0.710"	0.736"	0.013"	.044	4
651-BT-20M	\$.10	2.25"	0.710"	0.736"	0.013"	.036	4
BT-30, Parallel-Wound Paper Tube, for sport models							
651-BT-30	\$.25	9"	0.725"	0.767"	0.021"	.270	4
651-BT-30F	\$.25	7"	0.725"	0.767"	0.021"	.210	4
651-BT-30B	\$.20	6.125"	0.725"	0.767"	0.021"	.184	4
651-BT-30C	\$.20	5.5"	0.725"	0.767"	0.021"	.165	4
651-BT-30A*	\$.30	3.5"	0.725"	0.767"	0.021"	.105	4
651-BT-30J	\$.10	2.75"	0.725"	0.767"	0.021"	.082	4
BT-50, Spiral-Wound Paper Tube, for sport and high performance payload models							
651-BT-50	\$.40	18"	0.950"	0.976"	0.013"	.378	11
651-BT-50L	\$.30	12.7"	0.950"	0.976"	0.013"	.242	5
671-BT-50W	\$.25	9.5"	0.950"	0.976"	0.013"	.200	5
651-BT-50H	\$.25	7.75"	0.950"	0.976"	0.013"	.163	4
651-BT-50S	\$.15	4"	0.950"	0.976"	0.013"	.084	4
651-BT-50J	\$.15	2.75"	0.950"	0.976"	0.013"	.058	4
BT-55, Spiral-Wound Paper Tube, for sport and demonstration models							
651-BT-55	\$.50	18"	1.283"	1.325"	0.021"	.672	11
671-BT-55V	\$.50	16.35"	1.283"	1.325"	0.021"	.687	11
651-BT-55S	\$.20	4"	1.283"	1.325"	0.021"	.268	4
BT-60, Spiral-Wound Paper Tube, for sport and demonstration models							
651-BT-60	\$.60	18"	1.595"	1.637"	0.021"	.960	11
651-BT-60D	\$.45	11"	1.595"	1.637"	0.021"	.583	11
651-BT-60K	\$.35	7"	1.595"	1.637"	0.021"	.371	6
651-BT-60R	\$.25	5"	1.595"	1.637"	0.021"	.265	6
651-BT-60J	\$.15	2.75"	1.595"	1.637"	0.021"	.146	6
BT-70, Spiral-Wound Paper Tube, for monster models and tail rings							
651-BT-70	\$.85	17.5"	2.175"	2.217"	0.021"	1.30	14
RT-70, Spiral-Wound Paper Tube for tail rings							
671-RT-70A	\$.15	0.7"	2.175"	2.217"	0.021"	.050	4
Clear Plastic Tubes — for payload sections							
651-PST-20	\$.30	8"	0.710"	0.736"	0.013"	.168	4
651-PST-20J	\$.15	2.75"	0.710"	0.736"	0.013"	.058	4
651-PST-50S	\$.20	4"	0.950"	0.976"	0.013"	.110	4
651-PST-60R	\$.35	5"	1.595"	1.637"	0.021"	.350	6
651-PST-65R	\$.45	5"	1.750"	1.796"	0.023"	.450	6

*Replacement part for the Astron Scout, with holes punched. Be sure to give catalog number and length when ordering body tubes.

PAYLOAD SECTIONS



Ideal for payload launchings! Carry instruments, biological specimens, etc., in these light-weight, high capacity payload sections. These capsules come complete with all needed parts, including nose cone, body tube, nose block or adapter and screw eye.

Cat. No.	Price Each	Body Mat'l.	Weight oz.		Fits	Inside Dia.	Inside Length	Overall Length
			Net	Ship.				
651-PS-20A	\$.80	Clear Plastic	.16	1	BT-20	.710"	2"	4"
651-PS-20C	\$.85	Clear Plastic	.40	4	BT-20	.950"	3"	7"
651-PS-30B	\$.65	Regular Tube	.24	1	BT-30	.725"	2"	3.75"
651-PS-50A	\$.90	Clear Plastic	.39	4	BT-50	.950"	3"	6.50"
651-PS-50B	\$.85	Regular Tube	.36	4	BT-50	.950"	3"	6.50"
651-PS-50C	\$1.30	Clear Plastic	1.0	11	BT-50	1.59"	4"	10.5"
651-PS-50D	\$1.25	Regular Tube	.95	11	BT-50	1.59"	4"	10.5"
651-PS-50E	\$1.35	Clear Plastic	1.1	11	BT-50	1.75"	4"	10.5"
671-PS-55B	\$1.10	Regular Tube	.53	11	BT-55	1.28"	3"	7.63"
651-PS-60A	\$1.30	Clear Plastic	.98	11	BT-60	1.59"	4"	9.50"
651-PS-60B	\$1.25	Regular Tube	.90	11	BT-60	1.59"	6"	10.5"
651-PS-60C	\$1.35	Clear Plastic	1.0	11	BT-60	1.75"	4"	9.50"

MERCURY CAPSULE

PERFECT FOR PAYLOADS. Add a special touch to your rockets. Get this model Mercury Capsule. A big 1.8 inches in diameter and 3.2 inches high, this capsule is equipped with a removable base for easy payload access. Comes in easy to assemble kit form with a full set of adapters to fit the capsule to most Estes body tubes. Makes an ideal display model too. Shipping weight 3 ounces.



Cat. No. 651-PSM-1 \$1.00 each



NOSE CONES

Nose cone dimensions on opposite page — columns 1, 2 and 3.



Made of lightweight balsa, Estes nose cones are accurately machined to give you smooth surfaces, snug fit and uniformity.

BALSA BLOCKS FOR MAKING NOSE CONES OF YOUR OWN DESIGN



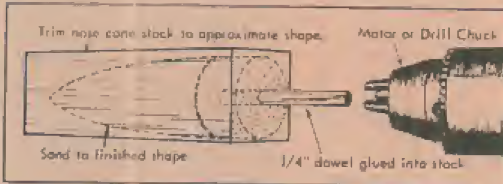
You can order nose cone stock in 4" to 6" lengths, perfect for turning your own nose cone shapes. These are cut-off pieces from our manufacturing process. Slightly damaged corners will not interfere with their usability. WITH EACH BLOCK ORDERED, ESTES INCLUDES A NOSE CONE DOWEL, NCD-2.

1" x 1" blocks, shipping wt. 1 oz.
Cat. No. 691-NCS-1A.....ea. \$.15

2" x 2" blocks, shipping wt. 3 oz.
Cat. No. 691-NCS-2A.....ea. \$.20

NOSE CONE DOWELS: 1/4" dia. x 2" long, hardwood. Use dowels as shown in drawing for making nose cones.

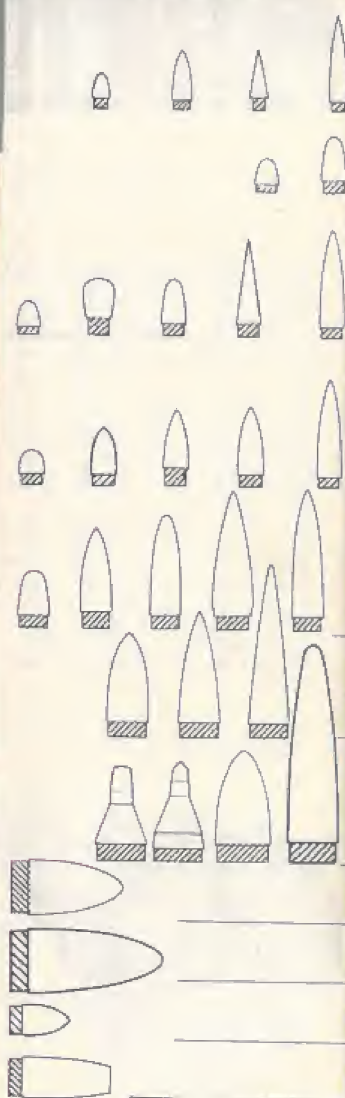
Shipping weight 2 oz.
Cat. No. 651-NCD-2.....3 for \$.10



SUGGESTION: When designing rockets using light-weight nose cones, be sure to follow procedures in TR-1 on rocket balance and stability. Don't forget to order screw eyes and nose cone weights: See pages 95 and 110.

Precision made for finer performance

Catalog No.	Price Each	Dimensions			Average Weight	Ship. Weight
		1	2	3		
LIGHTWEIGHT GEMS FOR BT-5						
651-BNC-5V	\$.25	3/4"	0.541"	1/4"	0.013 oz.	1 oz.
651-BNC-5E	\$.25	1 3/8"	0.541"	1/4"	0.020 oz.	1 oz.
651-BNC-5S	\$.25	1 1/2"	0.541"	1/4"	0.016 oz.	1 oz.
651-BNC-5W	\$.40	2 7/8"	0.541"	1/4"	0.039 oz.	2 oz.
PERFECT FOR BT-10						
651-BNC-10A	\$.25	13/16"	0.728"	1/4"	0.03 oz.	1 oz.
651-BNC-10B	\$.25	1 11/16"	0.728"	5/16"	0.05 oz.	1 oz.
VARIETY FOR A BT-20						
651-BNC-20A	\$.25	13/16"	0.736"	1/4"	0.03 oz.	1 oz.
651-BNC-20P	\$.25	1 5/16"	0.900"	7/16"	0.07 oz.	4 oz.
651-BNC-20B	\$.25	1 11/16"	0.736"	5/16"	0.05 oz.	1 oz.
651-BNC-20R	\$.40	2 3/4"	0.736"	3/8"	0.07 oz.	2 oz.
651-BNC-20N	\$.45	2 3/4"	0.736"	1/2"	0.08 oz.	2 oz.
BALSA BEAUTIES FOR BT-30						
651-BNC-30C	\$.30	3/4"	0.767"	3/8"	0.04 oz.	1 oz.
651-BNC-30D	\$.30	1 1/2"	0.767"	3/8"	0.06 oz.	1 oz.
651-BNC-30M	\$.40	1 1/2"	0.767"	1/2"	0.06 oz.	1 oz.
651-BNC-30E	\$.40	2 3/16"	0.767"	7/16"	0.07 oz.	1 oz.
651-BNC-30N	\$.45	2 3/4"	0.767"	1/2"	0.08 oz.	2 oz.
DESIGNED FOR THE BT-50						
651-BNC-50J	\$.40	1 3/8"	0.976"	1/2"	0.08 oz.	4 oz.
651-BNC-50K	\$.45	2 3/4"	0.976"	1/2"	0.13 oz.	4 oz.
651-BNC-50X	\$.50	3 1/4"	0.976"	1/2"	0.15 oz.	4 oz.
671-BNC-50AD	\$.75	4 1/16"	1.300"	1/2"	0.25 oz.	6 oz.
651-BNC-50Y	\$.75	4 3/8"	0.976"	3/8"	0.16 oz.	6 oz.
JUST RIGHT FOR THE BT-55						
651-BNC-55AA	\$.75	3 1/8"	1.325"	1/2"	0.15 oz.	4 oz.
651-BNC-55F	\$.75	3 7/8"	1.325"	1/2"	0.19 oz.	4 oz.
671-BNC-55AC	\$.80	5 3/8"	1.325"	3/8"	0.32 oz.	6 oz.
EXCLUSIVELY FOR THE BT-60						
671-BNC-60AB	\$.70	2 5/8"	1.637"	3/8"	0.23 oz.	4 oz.
651-BNC-60T	\$.75	2 7/8"	1.637"	1/2"	0.17 oz.	4 oz.
651-BNC-60L	\$.75	3 1/8"	1.637"	5/8"	0.34 oz.	4 oz.
681-BNC-60AH	\$1.50	6 5/8"	1.637"	7/8"	1.0 oz.	6 oz.
IDEAL FOR THE PST-65						
651-BNC-65L	\$.75	3 1/4"	1.796"	1/2"	0.41 oz.	4 oz.
FITS THE BT-70						
681-BNC-70AJ	\$1.50	4 1/4"	2.217"	1"	0.85 oz.	6 oz.
ESPECIALLY FOR OUR ENGINE MAILING TUBE						
651-BNC-MTD	\$.30	1 1/2"	1.002"	3/8"	0.06 oz.	4 oz.
AND A TAIL CONE FOR BT-55 (with pre-drilled hole)						
651-BTC-55Z	\$.75	3"	1.325"	1/2"	0.25 oz.	4 oz.



LIGHTWEIGHT PRECISION MADE PARTS for building your own rockets

NOSE BLOCKS

Use these top quality, featherweight balsa nose blocks in payload sections and anywhere else a solid bulkhead is required. Precision turned for exact fit in body tubes.



Catalog No.	Price Each	Outside Diameter	Length	Fits	Weight oz.	
					Net	Ship.
651-NB-20	\$.30	.710"	3/4"	BT-20	.014	1
651-NB-30	\$.30	.725"	3/4"	BT-30	.014	1
651-NB-50	\$.35	.950"	1"	BT-50	.040	4
671-NB-55	\$.45	1.283"	1 1/4"	BT-55	.115	4
651-NB-60	\$.50	1.595"	1 1/2"	BT-60	.190	4
651-NB-1MT	\$.35	.937"	1"	Mailing Tube	.040	4

STAGE COUPLERS

Little tubes with many uses, stage couplers exactly fit the inside of the tube designated. Great for multi-staging, joining body tubes, positioning adapter rings, etc. Make perfect guides for cutting body tubes and sanding cut edges of body tubes, too. Extra durable, lightweight. Shipping weight for all stage couplers is 3 oz. each.



Catalog No.	Price Each	Outside Diameter	Inside Diameter	Length	Fits	Average Weight
651-JT-5C	\$.10	.513"	.455"	3/4"	BT-5	.020 oz.
651-JT-20C	\$.10	.708"	.650"	3/4"	BT-20	.027 oz.
651-JT-30C	\$.10	.724"	.650"	3/4"	BT-30	.030 oz.
651-JT-50C	\$.15	.949"	.920"	1"	BT-50	.051 oz.
651-JT-55C	\$.15	1.28"	1.25"	1 1/4"	BT-55	.088 oz.
651-JT-60C	\$.15	1.59"	1.55"	1 1/2"	BT-60	.124 oz.
671-JT-70A	\$.20	2.175"	2.115"	1 1/4"	BT-70	.140 oz.

BALSA ADAPTERS

Super light, precision made balsa adapters give unlimited flexibility for model rocket design. Switch from one size body tube to another for payload capsules, parachute compartments, propulsion sections, etc. Adapters fitting BT-20 can be built up with masking tape to fit BT-30. Any adapter can be hollowed with a knife or drill to make a passage for ejection gases. All adapters have at least 1/2" mating surface on each end.

BALSA TUBE ADAPTER USES



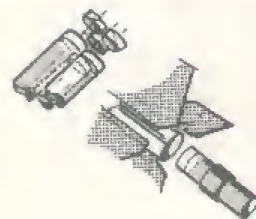
Pass ejection gases into larger tube

Adapt large payload tube to small booster

Catalog No.	Price Each	Mates	Length	Taper Length	Weight oz.	
					Net	Ship.
651-TA-520	\$.30	BT-5 to BT-20	1.75"	0.75"	0.04	1
651-TA-550	\$.35	BT-5 to BT-50	2.2"	1.0"	0.06	4
651-TA-2050	\$.40	BT-20 to BT-50	3.0"	2.0"	0.15	4
651-TA-2050A	\$.35	BT-20 to BT-50	2.0"	1.0"	0.11	4
681-TA-2055	\$.45	BT-20 to BT-55	2.5"	1.5"	0.22	4
651-TA-2060	\$.60	BT-20 to BT-60	3.0"	2.0"	0.20	4
681-TA-5055	\$.45	BT-50 to BT-55	2.0"	1.0"	0.60	4
651-TA-5060	\$.60	BT-50 to BT-60	3.0"	2.0"	0.23	4
651-TA-5065	\$.60	BT-50 to PST-65	3.0"	2.0"	0.26	4
681-TA-5560	\$.55	BT-55 to BT-60	2.2"	1.0"	0.25	4
681-TA-5565	\$.60	BT-55 to PST-65	2.7"	1.5"	0.38	4
651-TA-6065	\$.50	BT-60 to PST-65	2.0"	0.5"	0.23	4
681-TA-6070	\$.80	BT-60 to BT-70	2.7"	1.5"	0.65	4

ENGINE BLOCKS

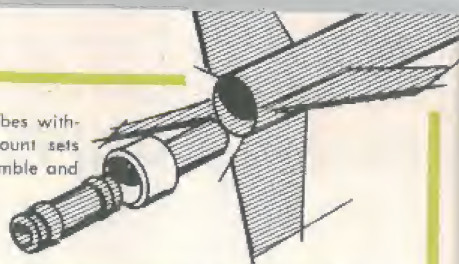
Use lightweight precision fitting engine blocks for the best internal construction on your models. Used for positioning the engine in your rocket for flight, engine blocks provide a hollow bulkhead against which the engine pushes as it develops its thrust, as well as an opening through which gases pass forward unobstructed for normal ejection.



Catalog No.	Price 3 for	Outside Diameter	Inside Diameter	Length	Fits	Weight oz.	
						Net	Ship.
651-EB-20A	\$.20	.708"	.65"	1/4"	BT-20	.009	1
651-EB-20B	\$.20	.708"	.65"	1/8"	BT-20	.005	1
651-EB-30A	\$.20	.724"	.65"	1/4"	BT-30	.010	1

ENGINE MOUNTS

Get a precision engine fit in large body tubes without adding unnecessary weight. Engine mount sets come complete with instructions — just assemble and glue in place in your model.



EH-2050 Fits BT-50, includes BT-20J, EB-20A, 2 rings for centering holder tube, and JT-50C for positioning rings. Net weight 0.1 oz. Shipping weight 5 oz.

Cat. No. 651-EH-2050 \$.35 each

EH-2055 Fits BT-55, includes BT-20J, EB-20A, 2 rings for centering holder tube, and JT-55C for positioning rings. Net weight 0.14 oz. Shipping weight 5 oz.

Cat. No. 651-EH-2055 \$.35 each

EH-2060 Fits BT-60, includes BT-20J, EB-20A, 2 rings for centering holder tube, and JT-60C for positioning rings. Net weight 0.17 oz. Shipping weight 5 oz.

Cat. No. 651-EH-2060 \$.35 each



PAPER ADAPTERS

Add still another dimension to rocket design. Easy to use paper adapters are perfect for making transitions between tube sizes for countless designs.

MULTI-PURPOSE SET — Includes a total of 20 rings for positioning BT-5 in BT-20; BT-5, BT-20, BT-30 in BT-50; and BT-5, BT-20, BT-30, and BT-50 in BT-60. Also three universal tapered shrouds and instructions. Shipping wt. 2 oz.

Cat. No. 651-TA-1 \$.35 each

20-50 RINGS — 20 rings for centering and mounting BT-20 in BT-50. Shipping weight 2 oz.

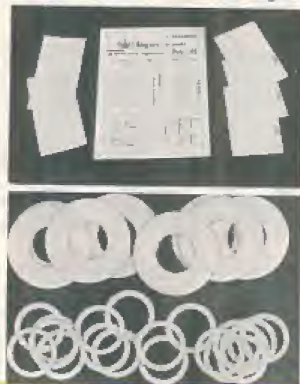
Cat. No. 651-RA-2050 \$.30 per set

20-55 RINGS — 10 rings for centering and mounting BT-20 in BT-55. Shipping wt. 2 oz.

Cat. No. 671-RA-2055 \$.30 per set

20-60 RINGS — 10 rings for centering and mounting BT-20 in BT-60. Shipping weight 2 oz.

Cat. No. 651-RA-2060 \$.30 per set



CENTERING RINGS



Easy to use for centering a BT-20 body tube within a BT-50. Offering good alignment and fit, the AR-2050 adapter rings' greater strength makes them a good choice for use in model rockets that are to be flown with high thrust engines. Weight per pair .285 oz. Shipping wt. 3 oz.

Cat. No. 681-AR-2050 10 for \$.40

FIN STOCK

Top quality balsa sheeting for making fins for model rockets. For maximum strength, grain of wood should follow the leading edge of fin. Read **FINS** in Vol. 3, No. 3 of the **MODEL ROCKET NEWS** for more information.



Catalog No.	Price	Dimensions (In Inches)	Weight oz.		Major Use
			Net	Ship.	
651-BFS-10	3 for \$.35	1/32 x 3 x 9	.065	4	High Performance
651-BFS-20	3 for \$.40	1/16 x 3 x 9	.130	4	High Performance
651-BFS-20L	3 for \$.55	1/16 x 3 x 12	.173	6	High Performance
651-BFS-20B	2 for \$.10	1/16 x 1/2 x 6	.015	2	Glider Elevon
651-BFS-30	3 for \$.45	3/32 x 3 x 9	.150	4	Sport Models
651-BFS-30L	3 for \$.60	3/32 x 3 x 12	.200	6	Sport Models
651-BFS-40	3 for \$.50	1/8 x 3 x 9	.200	4	Cluster Rockets
651-BFS-40L	3 for \$.65	1/8 x 3 x 12	.265	6	Glider Wings
651-BFS-60S	3 for \$.15	3/16 x 1/2 x 3.7	.020	2	Scout Fin Replacement
651-BFS-80	\$.30 each	1/4 x 2 x 17	1.00	12	Sky Slash Body

CLEAR PLASTIC FIN STOCK: Build flyable models of finless space boosters and retain scale appearance. Clear plastic fins can be practically invisible; yet can also be as large as needed for proper stability. Recommended practice is to form a tube of 0.020" thick plastic to slide onto the outside of your model and glue fins made from 0.040" thick plastic to this tube. Use clear butyrate dope for gluing and filleting. In 3" x 9" sheets, shipping weight 4 oz.

0.020" THICK: Cat. No. 651-CFS-20 \$.20 each

0.040" THICK: Cat. No. 651-CFS-40 \$.40 each



FIN PATTERN SHEET NO. 2: Fourteen different popular fin designs, all tried and proven, printed full size on heavy index stock. Simply cut out and trace around pattern to transfer design to balsa. A must for the model rocket designer. Shipping weight 1 oz.

Cat. No. 651-PP-2 \$.25 each

FIN PATTERN SHEET NO. 3: Fifteen different fin designs. Same stock as sheet No. 2. A great help in developing new rockets. Shipping weight 1 oz.

Cat. No. 681-PP-3 \$.25 each



Give
your
rockets
the
professional
look

DECALS



STARS AND BARS: Sheet of 12 red, white and blue Air Force emblems, each 1 1/4" wide. Fit on fins and body tubes, look great on gliders. Shipping weight 1 oz. Cat. No. 651-D-1 \$.15 each

LARGE STARS AND BARS: Add a special touch to your large models. Sheet contains two large 2" insignia, two medium 1 3/4" insignia and appropriate designations. Shipping weight 1 oz. Cat. No. 651-D-2 . . . \$.15 each

1/4" LETTERS AND NUMBERS: Ideal for code markings and identification on smaller rockets. Sheet contains 65 characters 1/4" high. Available in black or white. Specify color when ordering. Shipping weight 1 oz. Cat. No. 651-D-4 \$.15 each

3/8" LETTERS AND NUMBERS: Identify and decorate models the easy way with these 3/8" high letter and number decals. Sheet contains 62 characters. Available in black or white. Specify color when ordering. Shipping weight 1 oz. Cat. No. 651-D-3 \$.15 each

LAUNCH PANEL DECAL: Identify controls and circuits on your launch panel with this easy-to-apply, pressure sensitive decal sheet. Aluminum letters on black background are easy to read, add extra eye appeal. Self-adhesive, just cut out and press in place. Extra-strong mylar sheet measures 3 1/2" x 4 3/4". Shipping weight 1 oz. Cat. No. 651-D-10 \$.50 each

DECORATING TAPE, black: Thin, tough pressure sensitive tape is perfect for stripes, bars and other decoration. Easy to apply and only .0015" thick, decorating tape comes in rolls 1/2 inch wide and 144 inches long. Can be cut with knife and straightedge for special sizes. Cat. No. 651-DT-1, shipping wt. 5 oz. \$.25 each



Colorful decals are decorative and easy to apply. Just dip in water for about 30 seconds. Slide the paper off and apply to either flat or round surfaces of your rocket. Complete instructions included.

1/5" CHECKERBOARDS: Glossy, colorful 1/5" square checks on clear background. Add color contrast to model for easy tracking and eye appeal. Extra-large sheets, 9 1/2" x 4", available in red, black, gold or white. Specify color and check size when ordering. Shipping weight 1 oz. Cat. No. 651-D-7 \$.25 each

3/8" CHECKERBOARDS: Big 3/8" square checks for your large models. Cut out special patterns for even more striking effects. Large 9 1/2" x 4" sheets, available in red, black, white, gold or silver. Specify color and check size when ordering. Shipping weight 1 oz. Cat. No. 651-D-8 \$.25 each

COLOR STRIPES: Put vertical stripes and horizontal rings on models the easy way. Each sheet has ten stripes, 1/32" through 1/2" wide and 9 1/2" long. Available in red, black or yellow. Specify color when ordering. Shipping weight 1 oz. Cat. No. 651-D-9 \$.25 each

GOLD MINE SPECIAL: A real gold mine of decorative decals for your models. Lettering, vents, hatches, rivets and more, all on one big 3 1/2" x 8 1/2" sheet. Printed in brilliant red, white and black to add extra color. Shipping weight 1 oz. Cat. No. 651-D-5 \$.25 each

#1 KIT NAMES DECAL: Dress up models with these special kit names decals. Identify and decorate — easy to apply. Comes in black or white. Specify color when ordering. Shipping weight 1 oz. Cat. No. 651-D-6 \$.25 each

#2 KIT NAMES DECAL: Extra colorful, this decal includes names for kit numbers K-7, 9, 12, 14, 15, 16, 17, 18 and 20 on a big 3 1/2" x 8 1/2" sheet. Printed in stand-out colors of red, yellow, white and black, this sheet provides the extra touch for good looking models. Shipping weight 1 oz. Cat. No. 651-D-11 . . \$.25 each



FINISHING SUPPLIES

Estes finishing materials and a little extra care in finishing can make a big difference in your model rocket's professional appearance and performance efficiency. For model finishing information, see page 68.



ASTROSEAL balsal filler: The first step to a perfect finish. Astroseal contains an extra high percentage of selected fillers to completely fill the grain in balsal parts. Gives smooth surface for dope or enamel application. Brush on two to four coats, letting each dry thoroughly. Sand with #SP320 sanding material between coats. In four ounce jar. Shipping weight 7 oz.

Cat. No. 691-SS-2 \$.70 each



HEAT RESISTANT PAINT: Protect exposed rocket parts from heat damage with easy to apply, brush-on, high heat aluminum paint. Protects to 1000°, gives a bright metallic finish. Recommended for swept fins and other parts exposed to hot exhaust gases. In 1½ ounce bottles. Shipping weight 6 oz.

Cat. No. 651-AP-1 \$.35 each



FLUORESCENT SPRAY PAINT: The brightest colors anywhere — make rockets easy to spot in the air and on the ground. Glowing, high visibility paint comes in handy 6 oz. spray cans, dries in minutes. For maximum brilliance use glossy white enamel as an undercoat. Available in Cerise Red, Yellow Orange, Red Orange and Green. **Specify colors when ordering.** Shipping weight 16 oz. each.

Cat. No. 651-FP-1 \$1.40 each



ENAMEL SPRAY PAINT: Get that "professional" appearance for your best models. Top quality enamel in handy 5 oz. spray cans dries in minutes. Use indoors and outdoors. Not fluorescent. Available in the popular colors of True Blue, Bright Silver, Bright Gold, Cherry Red, Glossy White, Glossy Black, Flat White, Ultra Flat Black. **Specify colors when ordering.** Shipping weight 16 oz. each.

Cat. No. 651-EP-1 \$1.20 each



CLEAR SPRAY: Crystal clear spray coating goes on clear — stays clear. Gives extra gloss to enamel finishes, protects decals and decorations, makes fluorescent finishes smooth, durable and glossy. For best results, let paint dry thoroughly before applying clear spray, use several light coats for maximum gloss. In handy 5 oz. spray can. Shipping weight 16 oz.

Cat. No. 651-EP-2 \$1.20 each



BUTYRATE DOPE: The dope preferred by expert modelers for perfect finishes. Brushes on smoothly, easily, comes in convenient 1 oz. bottles. Available in Insignia Red, International Orange, Dark Green, Gloss Black, Insignia White, True Blue, Sky Blue, Aircraft Gray, Orange Yellow, Silver, Gold and Clear. **Specify colors when ordering.** Shipping wt. 4 oz.

Cat. No. 651-BRD-1 \$.20 each

SANDING SEALER: Fills small holes in balsal, paper and other porous materials, provides a smooth surface for paint or dope. To use, sand the surface, brush on sealer, let dry and sand again. Repeat as needed to obtain a glass-like surface. In 1 ounce bottles. Shipping weight 4 oz.

Cat. No. 651-SS-1 \$.20 each



THINNER: For diluting butyrate dope, sanding sealer and Astroseal, and for brush cleaning. Completely colorless — won't interfere with the drying action of the dope. Comes in 1 ounce bottles. Shipping weight 4 oz.

Cat. No. 651-BDT-1 \$.20 each



WHITE GLUE: Preferred for rocket building! Sets fast, gives super strong joints with wood, paper, cloth and other porous materials. In 2 ounce plastic squeeze bottle. Shipping weight 6 oz.

Cat. No. 651-WG-1 \$.40 each



BODY PUTTY: For super-sleek models. Fill cracks, holes, grain marks in balsal parts, make smooth fin-body joints. In 21 cc. tube. Shipping weight 5 oz.

Cat. No. 651-FM-1 \$.30 each



FINISHING WAX: For a high gloss finish so important to appearance and low drag. Apply with soft cloth, let dry and polish with soft dry cloth. Recommended only for use on enamel and butyrate finishes sold by Estes Industries. In 2 oz. jar. Shipping weight, 5 oz.

Cat. No. 651-FW-2 \$.80 each



SANDING MATERIAL: Fold, roll or crumple it for hard to reach places. Special mylar plastic backed abrasive sheet can be used over and over again. Helps you get a mirror finish. Extra fine 320 grit in easy to handle 2½" x 2¼" sheets. Shipping weight 1 oz.

Cat. No. 651-SP-320 3 sheets \$.10



SANDPAPER: Shape and smooth model rocket parts with these handy 3" x 3" sheets of top quality sandpaper. Available in three grades. **Specify grade when ordering.** Shipping weight 1 ounce for 6 sheets.

6 SHEETS MEDIUM — Cat. No. 651-SPM-2 \$.10

6 SHEETS FINE — Cat. No. 651-SPF-2 \$.10

6 SHEETS EXTRA FINE — Cat. No. 651-SPEF-2 \$.10

18 SHEETS ASSORTED (6 each) — Cat. No. 651-SPA-2 \$.25



PAINT BRUSHES: The set designed for model rocketry. You get one #1 brush for extra fine work, one #4 brush for normal work and one #6 brush for covering large areas rapidly. Brushes are 6" long with quality camel hair bristles set in nicked ferrules. Available in sets of three only. Shipping weight 2 oz.

Cat. No. 691-PB-3 \$.35 per set

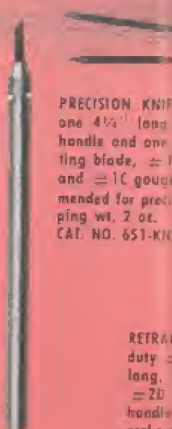


MASKING TAPE: Secure engines in model, mask for painting, etc. Extra strong ½" wide tape comes in 30 foot rolls. Flexible, seals tightly and strips off clean. Shipping weight 5 oz.

Cat. No. 651-MT-1 \$.30 each



MODELING TOOLS



PRECISION KNIFE SET: Includes one 4 1/4" long \pm 1 aluminum handle and one each \pm 1A cutting blade, \pm 1B punch blade, and \pm 1C gouge blade. Recommended for precision work. Shipping wt. 2 oz.
CAT. NO. 651-KNS-1 \$.75 each

RETRACTABLE BLADE KNIFE: Heavy duty \pm 2 aluminum handle, 4 1/4" long, with one double ended \pm 2D blade. Blade retracts into handle for safe carrying. For general cutting. Shipping weight 4 oz.
CAT. NO. 691-KNS-2 \$.125 each



UTILITY KNIFE: Includes 5 3/8" long \pm 3 steel handle and one \pm 3E general purpose blade. Shipping weight 3 oz.
CAT. NO. 651-KNS-3 \$.30 each



HEAVY DUTY KNIFE: Set of one 4 3/4" long \pm 4 plastic handle with metal chuck and one general purpose knife blade similar to \pm 4G. Shipping weight 6 oz.
CAT. NO. 651-KNS-4 \$.120 each

BLADES & ACCESSORIES



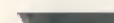
Fits \pm 1 handle only: For cutting balsa and paper.
CAT. NO. 651-KNB-1A \$.10 each



Fits \pm 1 handle only: Punch and scribe.
CAT. NO. 651-KNB-1B \$.25 each

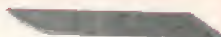


Fits \pm 1 handle only: Gauge for hollowing balsa nose cones, adapters, blocks, etc.
CAT. NO. 651-KNB-1C \$.25 each



Fits \pm 2 and \pm 4 handles. For general cutting and trimming.
CAT. NO. 651-KNB-4H \$.15 each

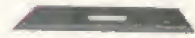
Fits \pm 2 handle only: Double ended, for general cutting.
CAT. NO. 651-KNB-2D \$.35 each



Fits \pm 2 and \pm 4 handles. For general cutting and carving.
CAT. NO. 651-KNB-4G \$.15 each



Fits \pm 2 and \pm 3 handles: Double ended, for general cutting.
CAT. NO. 651-KNB-3E \$.15 each



WHETSTONE: Keep knife blades extra sharp for easy cutting. Pocket size, 3 1/2" x 1 1/4" x 3/8". Use with oil for best results.
CAT. NO. 651-W-1 \$.50 each



TWEEZERS: For 1,001 uses in handling small parts, attaching shock cords, etc. Steel, 3" long, 1/8" jaw. Shipping weight 2 oz.
CAT. NO. 651-T-1 \$.20 each



EMERY BOARDS: Perfect for cleaning micro-clips, shaping airfoils, turning nose cones, etc. 4 1/2" x 1/4", medium abrasive on one side, fine abrasive on the other. Shipping weight 1 oz.
CAT. NO. 651-BE-1 . . . 3 for \$.10



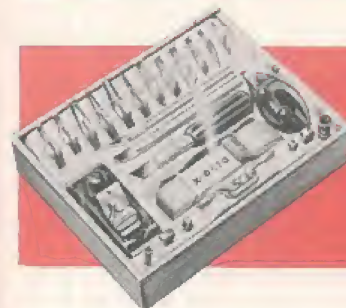
RAZOR SAW: Fits \pm 4 handle. 1" wide x 5" long. Use razor saw blade for cutting balsa and body tube.
CAT. NO. 651-KNB-4F . . . \$.45 each

Shipping weight on saw blade is 6 oz. all other blades, 1 oz.

MODELING KITS



KNIFE CHEST: Small, medium and heavy duty knives plus 9 assorted extra blades — one for practically every cutting job. In a handy, natural finish wood chest. Shipping wt. 1 lb. 8 oz.
Cat. No. 691-KNS-B2 \$4.95 each

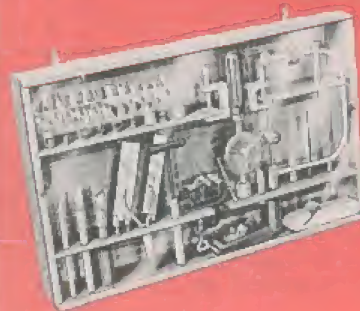


KNIFE AND TOOL SET: Contains small, medium and heavy duty knives and an entire assortment of blades, gouges, routers, and punches. Has planer, 1" sander, spokeshave and balsa stripper. In wooden box, complete with see-through cover and fitted plastic tray (insert fits) holds and shows every tool. Shipping wt. 2 lbs.
Cat. No. 691-KNS-B4 \$12.50 each

KNIFE SET: Conveniently packaged in a clear plastic case, the set contains scribe and 9 assorted blades to take care of most cutting needs. Balanced streamlined light weight aluminum handle. Shipping wt. 10 oz.
Cat. No. 691-KNS-24 \$2.50 ppd.



COMPLETE HOBBY DEN TOOL CABINET: A truly complete tool set for the model maker. Has a full assortment of hobby tools, knives and blades against a blueprint silhouette background of each tool for easy replacement. Comes in a sturdy wooden fitted cabinet with a sliding, see-thru cover. (Size 13 1/2" x 21 1/4" x 3") Shipping weight 9 pounds
Cat. No. 691-KNS-88N \$29.50 each



- | | |
|-------------------------------------|---|
| 6 Extra Blades | 1 Planer |
| 6 Assorted Gouges | 1 Hammer (with extra heads) |
| 4 Assorted Routers | 1 Bench Vise — Imported |
| 2 Punches | 1 Pair Pliers — Imported, service quality |
| 3 Knives (with blades) | 1 Drill Bit, 2 Screw Driver Bits |
| 1 Hobbycraft Saw (with extra blade) | 7 Rotor Saw Blades |
| 2 Screw Drivers | 2 Chucks |
| 2 "C" Clamps | |
| 1 Tweezer | |
| 1 Sander | |
| 3 Tweezer Clamps | |
| 1 Hand Drill | |
| 1 File | |

Plus Free copy of the 35c "PROJECT HANDBOOK AND HOBBY TOOL GUIDE" by X-acto

LITTLE ITEMS THAT GIVE BIG RESULTS IN ROCKETRY



PHANTOM ENGINE: For display and demonstrations, here's 1/2 an engine, cut the long way to show placement of nozzle, propellant, etc. Helps explain model rocket operation. Safe, uses only non-combustible materials. Shipping weight 1 oz.

Cat. No. 651-CE-1 \$.50 each



ENGINE HOLDER: Flat spring steel design gives easy installation and low drag. Recommended for sport and demonstration models built from BT-20 and BT-30, the engine holder is 2.8" long, 0.1" wide and only 0.025" thick. Mount it on the model with gauze and glue as shown on page 52. Net weight 0.032 oz. Shipping weight 1 oz.

Cat. No. 651-EH-2 \$.15 each



SHORT ENGINE HOLDER: Specially designed for use with Series III engines and BT-20 and BT-30 body tubes, this holder is 1.8" long and 0.1" wide for the same easy installation and low drag as the standard model. Net weight 0.022 oz. Shipping weight 1 oz.

Cat. No. 651-EH-3 \$.15 each



FOAM PADDING: Protect payload specimens, pad payload capsules with plastic foam. Pieces are 6" x 6" x 1/4". Can be cut and secured in place with white glue. Net weight 0.08 oz. Shipping weight 1 oz.

Cat. No. 651-PSP-1 \$.20 each



PAYLOAD: How high can your rocket lift an ounce of lead? This 1 oz. payload weight, 3/4" in diameter, is used in some altitude competition events. Shipping weight 2 oz.

Cat. No. 651-PL-1 \$.50 each



NOSE CONE WEIGHT: Balance rockets for perfect stability with these 11/16" diameter lead weights. Center hole for easy attachment and alignment. Stack several for more weight, cut with scissors for less. Each weighs 0.12 oz. Shipping weight 1 oz.

Cat. No. 651-NCW-1 3 for \$.25



NOSE CONE WEIGHT: 7/16" diameter brass washers for delicate balancing. 1/8" center hole, weighs 0.023 oz. Attach up to four weights to nose cone by threading them on the screw eye. Shipping wt. 1 oz.

Cat. No. 651-NCW-2 10 for \$.15



BALANCING WEIGHT: Flexible lead strip makes glider trimming a snap. Great for other balancing purposes too. Comes in 3" x 1/4" x 0.02" strips, net weight 0.085 oz. Shipping weight 1 oz.

Cat. No. 651-NCW-3 5 for \$.10

LAUNCH LUGS: Super strength laminated launch lugs feature mylar plastic core for durability, paper outer layer for easy gluing. Inside diameter 5/32", fit 1/8" rod. Shipping weight 1 oz.

1 1/4" long:	Cat. No. 691-LL-2A	6 for \$.15
2 3/8" long:	Cat. No. 651-LL-2B	5 for \$.15
5" long:	Cat. No. 651-LL-2C	3 for \$.15
8" long:	Cat. No. 651-LL-2D	2 for \$.15



GAUZE REINFORCING: Attach shock cords, reinforce fin joints with unmarked gauze. Comes in 3" x 12" sheets. Apply by spreading a thin layer of glue over the area to be reinforced, smooth gauze down over the glue and spread one or more layers of glue over the gauze. Shipping weight 1 oz.

Cat. No. 651-GR-2 3 for \$.30



PAPER REINFORCING: Double fin strength with this easy to use self-adhesive treated paper. Cut to shape, strip off protective backing and press on the balsa. Apply to both sides of the balsa for best results. Provides smooth white surface for painting. In 3" x 9" sheets. Shipping weight 1 oz.

Cat. No. 651-PRM-1 3 for \$.20



TAPE HINGES: Easy to use elevon hinges for boost-gliders. Treated paper, 4 1/2" x 3/4", adhesive coated on one side. Strip off protective backing, apply to joint. Shipping weight 1 oz.

Cat. No. 651-TH-1 2 for \$.10



ELASTIC THREAD: Strong elastic thread, use as a spring to actuate elevons on boost-gliders. Each thread is 8" long, 1/32" diameter. Shipping weight 1 oz.

Cat. No. 651-ET-1 3 for \$.10



NYLON SCREWS: Extra light, high strength screws for elevon adjustment on boost-gliders. 1/2" long, 1/16" thread diameter. Read TR-4 for information on gliders and their design. Shipping weight 1 oz.

Cat. No. 651-AS-1 \$.10 each



STYROFOAM BALLS: Featherweight 3" diameter styrofoam balls for "odd ball" designs. Use white glue for best results in attaching legs, antennas, stabilizers, etc. Net weight 0.2 oz., shipping weight 5 oz.

Cat. No. 651-SB-3 \$.25 each



DOWELS: Extra strong, light weight, seasoned maple dowels. Shipping weight 5 oz.

1/8" x 18" —	Cat. No. 651-WD-1	4 for \$.20
1/12" x 12" —	Cat. No. 671-WD-2	4 for \$.20



ALTISCOPE

Determine Rocket Altitudes

Learn Math and Trig



Patent #401,708,147

How high did it go? Find out with the Altiscope! Only one instrument is required for determining approximate altitudes (usually within ten percent). Use two together for even greater accuracy. Your altiscope can also be used to find heights of trees, buildings, mountains, poles, etc. Easy to assemble, easy to use, the Altiscope comes in kit form complete with instructions, trig tables, technical report TR-3 on altitude tracking and 2-D altitude computer. Shipping wt. 20 oz.

Cat. No. 651-A-1 \$2.50 each

EASY TO USE!

Computing Equipment

2-D COMPUTER: Build your own easy-to-use altitude computer. Get this set of charts and instructions — everything you need except tape, thumbtacks, and glue — assemble the 2-D computer in a few minutes. Designed for use with one or two Altiscopes, easily used with other tracking systems. Shipping weight 2 oz. Kit includes technical report, TR-3

Cat. No. 651-AC-1 \$.25 each p.p.

DIAL SCALE: No more guesswork. Weigh your birds — or any of the parts. Calibrated in both grams and ounces, it is accurate to within 2 grams at full load. Weighs items up to 9 oz. For rockets just slip hook into launch lug, or a pan can be improvised. Shipping wt. 5 oz.

Cat. No. 691-WS-1 \$3.25

6" POCKET SLIDE RULE: Ideal companion to the Altiscope. This durable plastic rule is complete and accurate, features A, B, C, CI, D and K scales on front plus S, T, and L scales on back for computing altitudes and working logarithm problems. With vinyl case and instructions. Shipping weight 5 oz.

Cat. No. 651-SR-3 \$1.10 each p.p.

10" DECIMAL TRIG MULTI-LOG SLIDE RULE: A big rule at a small price. Complete with 22 scales in a functional grouping for mathematics, science and engineering — covers full log-log and trig requirements. Includes double faced, spring loaded adjustable cursor, operating instructions and protective carrying case. Shipping weight 11 oz.

Cat. No. 651-SR-4 \$3.25 each p.p.

See page 123 for book, "Learn Basic Slide Rule" (incl. slide rule)

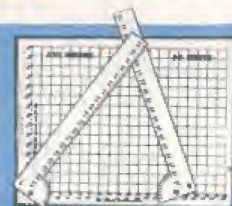
GRAPH PAPER: For rocket performance charts, stability graphs and countless other uses. 8½" x 11" sheets with 7½" x 10" grid area, divided into 1/10" squares. Shipping weight 4 oz.

Cat. No. 651-GP-1 20 sheets for \$.40

LOG-LOG GRAPH PAPER: Perfect for special performance graphs, altitude and velocity charts, etc. Two by two cycle grid on 8½" x 11" paper, can handle greater value ranges than standard graph paper. Shipping wt. 4 oz.

Cat. No. 671-GP-2 20 sheets for \$.40

FLIGHT DATA SHEETS: New double size (11" x 17"), printed on both sides. One side has spaces in sequence for pre-flight, count-down, launch and flight summary data. Other side is a rocket designers plan sheet with a large ¼" grid space for ease in drawing your plans. Ship. wt. 2oz. Cat. No. 681-DS-2 5 for \$.20



Inserts show actual size



CUSTOM ASSORTMENTS

Many new, unique and useful rocket designs have been produced by imaginative rocketeers. In this section you'll find representative money-saving assortments of components for the beginner and for the experienced rocketeer who wants to explore new designs and ideas.

LAUNCH PAD SPECIAL

Perfect starter assortment for a basic foundation

Designed around the durable BT-30 body tube . . . for easy to build, long-lasting "birds".

Contains all parts and supplies necessary for the experimentally minded rocketeer to explore techniques of successful rocket building. A comprehensive design manual guides you to hours of fun and satisfaction in building serviceable rockets. A good basic assortment for studies in aerodynamics, stability and recovery techniques.

**\$8.20 VALUE
ONLY \$5.00**

Cat. No. 691-ES-50A, shipping wt. 1 lb., 2 oz. \$ 5.00

BODY TUBES
6 Body Tubes #BT-30

NOSE CONES
2 Nose Cones #BNC-30C
1 Nose Cone #BNC-30D
1 Nose Cone #BNC-30E
1 Nose Cone #BNC-30M
1 Nose Cone #BNC-30N

RECOVERY EQUIPMENT
2 Parachutes #PK-12A
1 Parachute #PK-8A
1 Parachute Material #PM-2
1 Streamer Material #SM-1
1 Sheet Tape Strips #TD-2
1 Roll Shroud Lines #SLT-1
6 Shock Cords #SC-1
6 Screw Eyes #SE-2

FIN MATERIAL
4 Balsa Fin Stock #BFS-20
2 Balsa Fin Stock #BFS-30
MISCELLANEOUS
6 Engine Blocks #EB-30A
3 Launch Lugs #LL-2C
1 Design Manual #P-1
1 Fin Pattern Sheet #PP-2
1 Fin Pattern Sheet #PP-3

KEEP A SUPPLY ON HAND

PARTS FOR YOUR OWN
ROCKET DESIGNS



LIFT-OFF SPECIAL

Lift-off to more rocket building enjoyment with this special-value assortment. A balanced selection of parts and supplies to build and decorate many different types of rockets. Real savings. Great for gifts, or for yourself as you build advanced or experimental models.

Shipping wt. 1 lb., 12 oz.

**FOR BUILDING
AN ALL-PURPOSE
ROCKET FLEET**

**\$14.50 VALUE
only \$10.00**

Cat. No. 691-ES-100A

\$10.00

FIN MATERIAL

1 Balsa Sheet #BFS-10
2 Balsa Sheets #BFS-20
3 Balsa Sheets #BFS-30
2 Balsa Sheets #BFS-40

NOSE CONES

1 #BNC-60L 1 #BNC-20B
1 #BNC-30E 1 #BNC-20N
1 #BNC-30M 1 #BNC-10A
1 #BNC-20A 1 #BNC-10B

BODY TUBES

1 #BT-60 2 #BT-20
2 #BT-30 2 #BT-10H

BULKHEADS AND HOLDERS

1 #NB-60 3 #EB-30A
1 #NB-30 3 #EB-20A
1 #NB-20 1 #EH-2060

RECOVERY EQUIPMENT

1 Parachute #PK-8A
2 Parachutes #PK-12A
1 Parachute #PK-18A
1 Parachute #PK-24A
1 Parachute Material #PM-2
1 Streamer Material #SM-1
2 Sheets Tape Strips #TD-2
1 Roll Shroud Lines #SLT-1
3 Snap Swivels #SV-12
9 Screw Eyes #SE-1
6 Shock Cords #SC-1
1 Shock Cord #SC-2

MISCELLANEOUS

1 Balsa Adapter #TA-2060
1 Adapter Set #TA-1
1 Nose Cone Stock #NCS-1
1 Nose Cone Stock #NCS-2
3 Nose Cone Dowels #NCD-1
6 Nose Cone Weights #NCW-1
3 Reinforcing Mat'l. #PRM-1
3 Launching Lugs #LL-2C
1 Decal Sheet #D-5
1 Design Manual #P-1
1 Fin Pattern Sheet #PP-2
1 Fin Pattern Sheet #PP-3



ORBIT SPECIAL

You or your club members will "orbit" a whole host of rockets before this value-packed assortment has been used. With the representative selection of parts and supplies included, your imagination will have a chance to run free on many rocket projects and experiments. Valuable design manual included. Shipping weight 2 lbs.

Cat. No. 691-ES-150A \$15.00 ea.

RANGE KIT SPECIAL

A Complete Range Kit

**\$9.00 VALUE
ONLY \$6.00**

A sturdy, all metal range box (RB-1), loaded with all these most needed items:



- | | | | |
|----------------------|-------------------------------------|---------------------|----------------------|
| 21 Igniters | 1 Roll Shroud Lines | 3 Screw Eyes | 1 Engine Holder |
| 1 Bottle White Glue | 1 Sheet Tape Strips | 3 Nose Cone Weights | 1 Reinforcing Mat'l. |
| 1 Knife Handle | 2 Packs Flameproof Recovery Wadding | 1 Roll Masking Tape | 3 Snap Swivels |
| 3 Knife Blades | 4 Parachutes | 2 Balsa Fin Stock | 4 Shock Cords |
| 1 Tweezers | 1 Streamer Material | 3 Launching Lugs | 1 Emery Board |
| 5 Flight Data Sheets | 18 Sheets Sandpaper | 2 Micro-Clips | |

Shipping weight 3 pounds. Sorry, no substitutions.
Cat. No. 651-RBK-1 \$6.00

RANGE BOX

Good-looking, roomy, tough all-metal box — the same as included with the special above. A big 11½" x 5¼" x 4", complete with a three compartment tray for small parts. Has full-drawn seamless body, snap catch with eye for padlock. Shipping weight 2 pounds.

Cat. No. 651-RB-1 \$2.50 each

LARGE RANGE BOX

Big enough to hold an Altiscope, an Electro-Launch and a model or two, this sturdy all steel range box measures 19" x 7¼" x 6". Watertight construction protects your supplies, double action latch eliminates spilling, multi-section tray helps keep things organized. Shipping weight 6 pounds.

Cat. No. 651-RB-2 \$6.00 each

LARGE RANGE KIT SPECIAL

Includes the large range box with the same supplies as the regular range kit special. Shipping weight 7 lb.
Cat. No. 651-RBK-2 \$9.50 each



**\$12.50 Value
Only \$9.50**

ADAPTERS

- 1 Balsa #TA-2050A
- 1 Balsa #TA-2060
- 1 Balsa #TA-5060
- 1 Paper #YA-1

FIN MATERIAL

- 3 Balsa Sheets #BFS-10
- 3 Balsa Sheets #BFS-20
- 3 Balsa Sheets #BFS-30
- 3 Balsa Sheets #BFS-40

MISCELLANEOUS

- 1 Payload Section #PS-20A
- 1 Nose Cone Stock #NCS-1
- 1 Nose Cone Stock #NCS-2
- 3 Nose Cone Dowels #NCD-1
- 6 Nose Cone Weights #NCW-1
- 3 Reinforcing Mat'l. #PRM-1
- 1 Reinforcing Mat'l. #GR-2
- 6 Launching Lugs #LL-2C
- 1 Decal Sheet #D-5
- 1 Decal Sheet #D-6
- 1 Design Manual #P-1
- 1 Fin Pattern Sheet #PP-2
- 1 Fin Pattern Sheet #PP-3

**\$21.15 Value
only \$15.00**

NOSE BLOCKS, ENGINE BLOCKS, HOLDERS, ETC.

- 1 Nose Block #NB-60
- 1 Nose Block #NB-50
- 1 Nose Blocks #NB-30
- 2 Nose Blocks #NB-20
- 3 Engine Blocks #EB-30A
- 3 Engine Blocks #EB-20A
- 1 Engine Mount #EH-2050
- 1 Engine Mount #EH-2060
- 1 Stage Coupler #JT-50C
- 1 Stage Coupler #JT-60C

BODY TUBES

- 1 #BT-60
- 1 #BT-50
- 3 #BT-30
- 2 #BT-20
- 2 #BT-10H

NOSE CONES

- 1 #BNC-60L
- 1 #BNC-50K
- 1 #BNC-30D
- 1 #BNC-30E
- 1 #BNC-30M
- 1 #BNC-20A
- 1 #BNC-20B
- 1 #BNC-20N
- 1 #BNC-10A
- 1 #BNC-10B

RECOVERY EQUIPMENT

- 1 Parachute Material #PM-2
- 2 Parachutes #PK-8A
- 3 Parachutes #PK-12A
- 2 Parachutes #PK-18A
- 1 Parachute #PK-24A
- 3 Streamer Material #SM-1
- 2 Sheets Tape Strips #TD-2
- 1 Roll Shroud Lines #SLT-1
- 6 Shock Cords #SC-1
- 3 Shock Cords #SC-2
- 12 Screw Eyes #SE-1
- 3 Snap Swivels #SV-12

Let your model design win an award!

Enjoy designing new models?

- Payload •Duration •Boost-glide
- Launchers •Telemetry devices
- Odd-ball •or you-name it

ENJOY \$
IT MORE
WITH A **50** MERCHANDISE AWARD

ESTES

DESIGN
OF THE MONTH
COMPETITION

Here's a contest for every rocketeer. You can get a lot more from it than just an award. Estes Industries sponsors this contest to encourage and reward original thinking among model rocketeers. Put your originality to the test. Enter soon!

NEW CONTEST EVERY MONTH . . . Send as many entries as you like

All plans which reach Estes Industries during the calendar month will be considered for that month's award. Each month the winning designer will receive a \$50.00 merchandise coupon and an award suitable for framing. We will send an acknowledgement of each entry received but will not be able to enter into any other correspondence concerning entries.

DESIGN OF THE MONTH RULES ARE FEW . . . AND EASY TO FOLLOW

Entries will be judged on practicality, originality, neatness and clarity. Plans do not have to be flight tested and proven. However, a proven design is more apt to win. Launchers and other accessory items will also receive extra points if they have been field tested and results noted with entry. Photos are not required, but you may include a picture of your completed design if you wish.

RULES: 1. All entries become the property of Estes Industries; none can be returned.

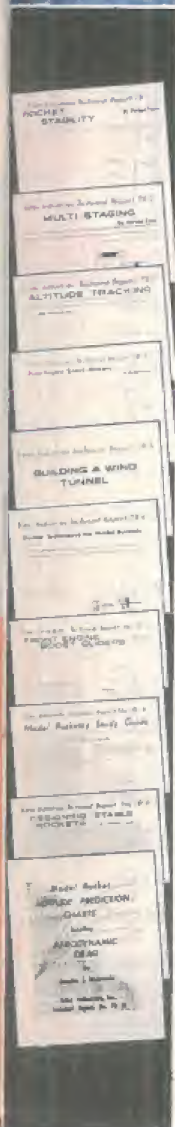
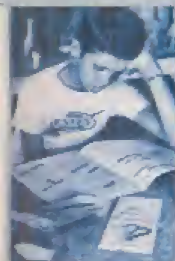
2. Employees of Estes Industries and members of their immediate families are not eligible to enter.

3. Designs should be sent to the Design of the Month Editor, Estes Industries, Inc. Box 227, Penrose, Colorado 81240. However, all plans sent to us which are not specifically addressed to another contest or department will be automatically placed in the Design of the Month competition.

Award winners will be notified by mail. The name of the winner of each award will then be announced in the next issue of the Model Rocket News.

A FEW TIPS IN PREPARING YOUR ENTRY

Designs should be new, original and different — but they also need to be workable. The goal is to develop something that other rocketeers can build and use successfully, too. If you're not sure your design will work, a little extra effort to make it work will be worth while. This way you gain additional engineering experience and also have a better chance to win.



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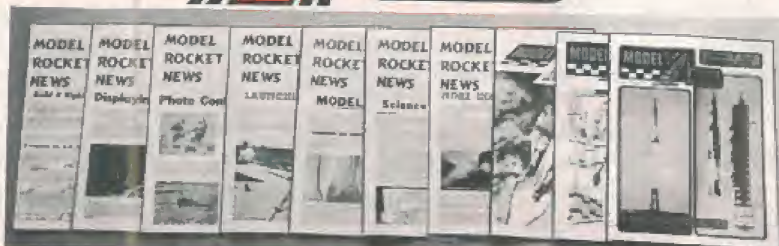
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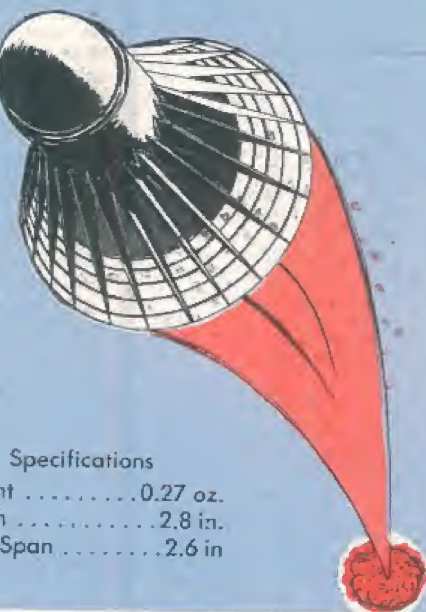
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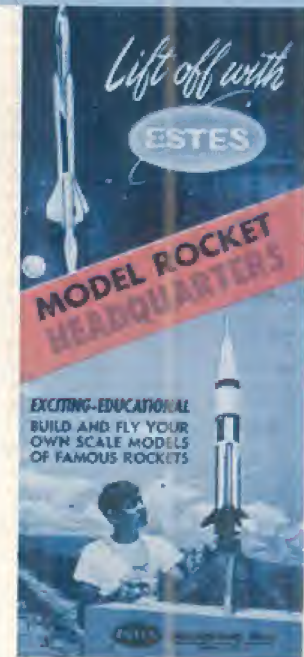
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